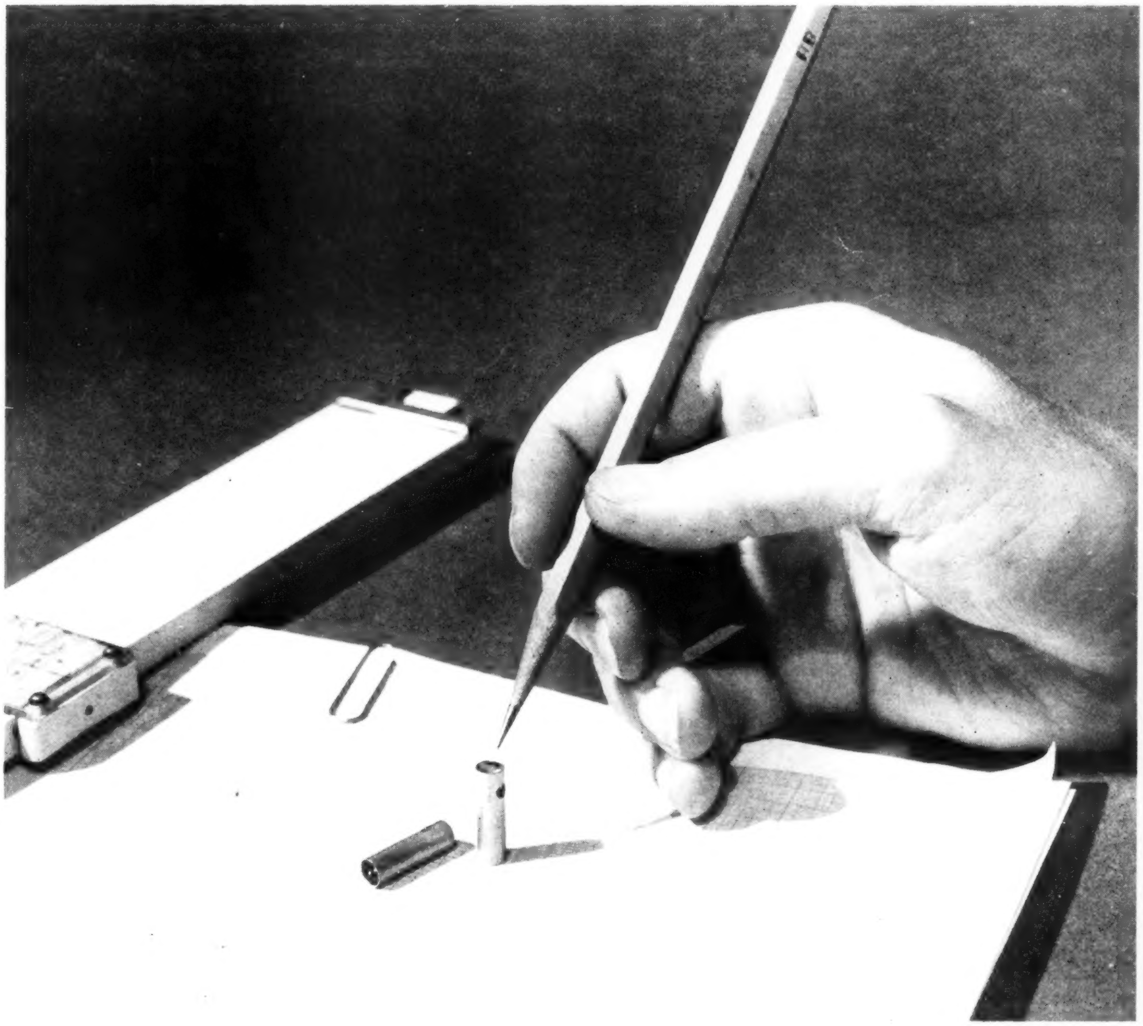
Midwest Engineer



WESTERN SOCIETY OF ENGINEERS
FOUNDED 1869

ORGANIZED CREATIVE TECHNOLOGY

WSE MEETINGS — PAGE TWO

NOVEMBER, 1949 No. 3

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Serving the Engineering Profession

November, 1949 CONTENTS Vol. 2, No. 3

COVER CREDIT

The invention of the transistor "was an incident, not an accident" . . . in the course of the Basic Research program at Bell Laboratories. This is one of the developments described in "Organized Creative Technology," beginning on Page 3.

Western Society Activities in November

(Monday night is WSE night at our Headquarters)

Civic Committee, Sponsor, Nov. 14

Alderman George D. Kells will represent the City administration Monday, November 14, when he describes for WSE members the public works program of Chicago. Economic, technological, political and neighborhood problems will be included in the general subject, "Problems in Developing Public Works in a Metropolitan Center."

Joint Meeting, November 28

A panel of three speakers will discuss "Superhighways in the Making for Chicago and Cook County," November 28, at a joint meeting of the Traffic Engineering and City Planning section and the Hydraulic, Sanitary and Municipal Engineering section.

Speakers will be Dick Van Gorp (MWSE), Chief Subway Engineer of the Department of Subways and Superhighways, City of Chicago; William J. Mortimer, Assistant Superintendent of the Cook County Highway Department, and Charles Apple, Division Engineer, Highway Department, State of Illinois.

They will discuss Chicago area superhighway development as it pertains to their particular sections of the projects.

Fire Protection & Safety, Dec. 5

Lt. Frank Andrews, Director of the Traffic Division of the Evanston Police Department will speak before the Fire Protection and Safety Engineering section on Monday, December 5th, at 7 p.m., in the WSE Headquarters.

His subject will be "Testing the Drinking Driver." A person may be perfectly sober and still appear to be well under the influence of liquor, according to Lt. Andrews, who will describe the modern chemical method of testing for intoxication and will explain why the older objective symptom method is not reliable.

Lt. Andrews has spent fifteen years in the Traffic Division of the Evanston Police Department and is a member of the faculty of the Northwestern University Traffic Institute. He has been a member of the Committee on Tests for Alcohol, of the National Safety Council, for the past ten years.

Women's Council

The Professional Women's Council of WSE has announced its schedule for the coming year.

Meetings will be held on Wednesdays in the small auditorium on the following dates: November 9, December 14, January 11, February 8, March 8, and April 12. They will sponsor a general meeting of WSE on Monday, May 15, 1950.

Electrical Engineering, Nov. 21

WSE members will adjourn after dinner on Monday, November 21, to the Bell Telephone Company Forum, 311 W. Washington St., for a lecture demonstration of telephone and television transmission called "Words Over Waves."

Developed by Illinois Bell Telephone Co., the display presents a simplified down-to-earth explanation of microwaves, latest scientific advancement in the communications field. Volunteers from the audience will speak over a miniature microwave radio circuit set up on the stage, to illustrate how television and telephone messages are shot from tower to tower. The miniature microwave radio relay system is a replica of the system which will be operating between New York and Chicago next year.

The audience hears how an inverter scrambles speech on overseas calls and then unscrambles it so that it is coherent to the person on the receiving end, thousands of miles away. Other special attractions include the new transistor, which is put to actual use, and synthetic crystal, with a demonstration of how its mechanical energy is converted into electrical energy.

John H. Simpson, Staff Supervisor in the Commercial Department of Illinois Bell, will be the speaker.

Dinner will begin at 5:30 p.m., in the WSE dining room at 84 E. Randolph St., and the demonstration will begin at 7 p.m., at the Illinois Bell Forum. Movies will be shown from 6:30 to 7 p.m.

Gas, Fuels and Combustion, Dec. 12

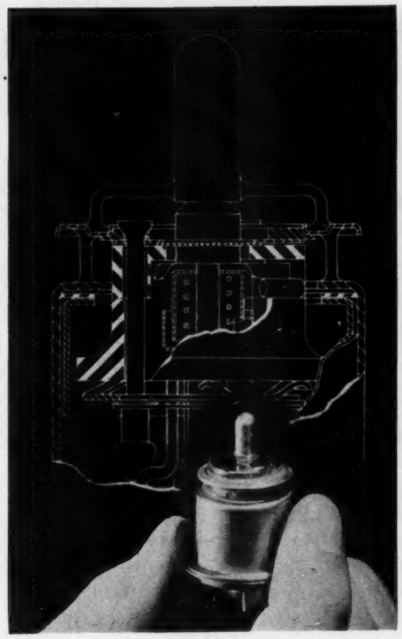
"Bikini, the Engineering and Human Side," will be Forest Nagler's subject when he speaks December 12, at WSE Headquarters. He is Chief Engineer of Allis-Chalmers Manufacturing Company.

Mr. Nagler will exhibit film depicting some of the careful preparation preceding the bursting of the atomic bomb at Bikini. As an executive directing design and manufacture for a large industrial firm, he is in an enviable position to predict how atomic energy may be harnessed for our national welfare.

His humorous manner of presentation, and his willingness to answer questions from the audience, will make this an interesting meeting.

Guest Cards Available

Guests cards for wives and adult daughters of members are now available. See Page 12 for details.



Organized Creative Technology

Dr. Mervin J. Kelly
Executive Vice President
Bell Telephone Laboratories
Murray Hill, N. J.

It is unnecessary in these days to stress the contributions of science to the progress of our civilization. By its application to the conversion of nature's store of materials and energy, not only has wealth been increased, but the standard and scope of living have been raised, more leisure has been acquired, and man's health has been improved at the same time that his span of life has been lengthened.

Even before the development of the scientific method in the fifteenth century, man was slowly raising his standard of living and widening his horizons by the empirical approach to nature's abundance. With the dawn of the Renaissance, the evolution of the scientific method had its beginnings in the work and thinking of such pioneers as Bacon and Galileo. Since then, scientific and ordered procedures have slowly evolved for the more complete conversion of nature's abundance to the uses of man. At the beginning of our present century, however, forces and procedures came into being that made a distinct break with the past and greatly accelerated the pace of progress. In the following half century, the time of our generation, more has been accomplished than in all previous history.

Detailed analysis of many of the aspects of the enrichment of our living through science and technology have appeared in recent literature, and it is a topic frequently presented to general audiences. It is not my purpose to add, even from a different point of view, to this story that has been told many times before. Rather, I wish to present to you, as well as I can within the time limitation, the structure, methods, and contributions of "Organized Creative Technology." Beginning only some fifty years ago, it has become tremendously effective. In each succeeding year, improvement has been made, and the end is not yet in sight. Even at its present stage, "Creative Technology" is so effective that many are quite properly concerned as to how the abundance of its output and the accompanying changes in our patterns of work and living can be absorbed without grave dangers to our social structure.

Progress was still slow in the last century, even after some 300 years of evolution of the scientific method. This was due not only to the limited number of scientists, and the slowness of communication, but to the "hit or miss" methods of procedure. The scientists of our universities were discovering the laws of natural phenomena at a slowly increasing pace, and putting them into ordered systems of knowledge through classification. The disciplines of chemistry, physics, and mathematics had stemmed from Natural Philosophy. Faraday's discovery of nature's laws of electrochemical equivalences, Ampere's determination of the laws of interrelation of an electric current and its magnetic field; Maxwell's masterful development of the equations of electromag-

(*Continued on Page 4*)

Dr. Kelly believes that "Organized Creative Technology," is the dominant force in our present day society. Its contributions, organization and methods are described and illustrated.

He earned his Ph.D. at the University of Chicago in 1918, received the D.Eng. at the University of Missouri in 1936 and the D.Sc. at the University of Kentucky in 1946. Dr. Kelly is a fellow of the American Physical Society, American Acoustical Society, Institute of Radio Engineers, and the American Institute of Electrical Engineers, and a member of the National Academy of Sciences.

Associated with Bell System Research and Development activities since 1918, he was Director of Research and Development of Electronics and Transmission Instruments from 1933 to 1936. From 1936 to 1948 he was Director of Research of Bell Telephone Laboratories, and has been Executive Vice President since 1948.

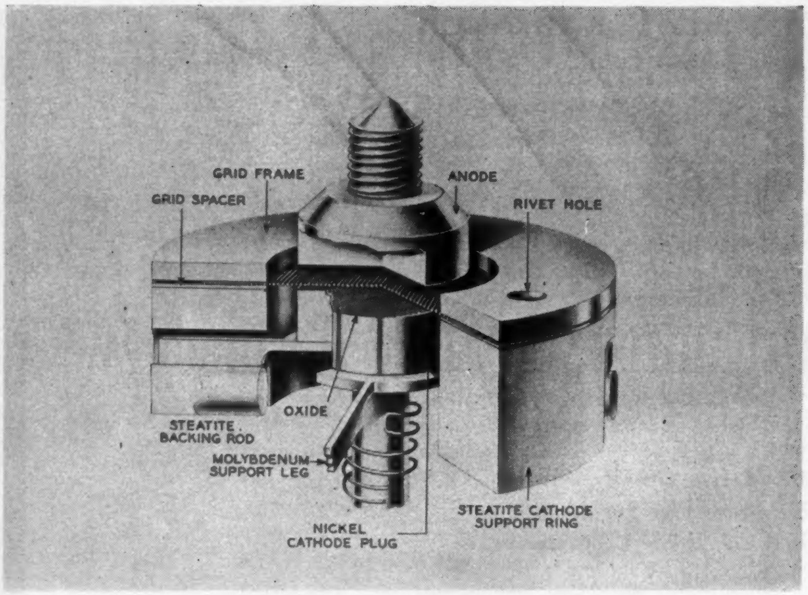
Organized Creative Technology

(*Continued from Page* 3)

netic radiation, and Hertz's discovery of its existence are only a few typical examples of the new discoveries. Many, many more of the basic laws to which the matter and energy content of our world conform were discovered and clearly enunciated. This new knowledge was slowly absorbed by many in the non-scientific world. With the new knowledge as a background, those who had that spark of creative genius that is essential for invention made important inventions that were basic to creating wealth and raising living standards. Edison, Bell, Watt, Marconi, and Wright are typical of the creative genius of the last century that through invention brought into being the beginnings of many tools, materials, and processes fundamental to man's more abundant living and wider horizons.

These inventors, in general, were not associated with the universities where the research was done, and did not come into contact with the scientists engaged in it—in fact, they were often scorned by them. Also their inventions most often occurred many years after the new knowledge that made them possible had been obtained. After these inventions were made, again with no ordered procedures, and frequently with much time lag, manufacturers, starting with the inventors' models, proceeded to get them into form for manufacture and use. This procedure was carried out, largely in the manufacturing plant, by men promoted from the shop bench and drafting board. While they were usually endowed with an engineering type of mind, most of them had little or no formal training.

This hit-or-miss procedure of the nineteenth century that I have so hastily sketched—pure science, invention, and practical design for manufacture, each uncoordinated with the others—did make progress in raising our living standards. It also made evident the need for the ordered, systematic, and rapidly moving procedure that has been developed in the present century. Seeking inspiration in the reservoir of knowledge arising from pure science research, the new method proceeds by interlocked and coordinated steps to the final design for mass production of new products, which —principally because of the resulting low cost—have an ever-widening area of use.



A broken-away view of one of the co-planar triodes.

Industrial research laboratories entered as a new element in this chain of events early in this century. The General Electric laboratories were created under the leadership of the able pure chemist Dr. Willis R. Whitney; the research laboratories of the du Pont industries under that of another basic chemist, Dr. C. M. A. Stine; and the Bell system research effort under the leadership of the pure physicist, Dr. Frank B. Jewett. Additional industrial research laboratories also came into being, first at widely spaced intervals of time but with an ever-increasing frequency, until today according to the last report for the National Research Council, there are some 2500 industrial research laboratories in our country.

These infant laboratories, staffed only in part by men adequately trained in pure scientific research, undertook, by employing the scientific method, to create new tools, materials, and processes of interest to their respective industries. The development of these laboratories was indeed rapid. With experience they made themselves increasingly effective, and gradually built up their scientific strength through wise recruitment from our graduate schools of science. To varying degrees, however, there existed a barrier between them and those of their companies who engineered and manufactured the new products. It limited the effectiveness of this important new element of industrial organization. This barrier could well have been expected. It was principally due to the lack of familiarity of these scientists with the limitations and problems of industrial production, to the inadequate technical training of the engineering and manufacturing staffs and to their distrust of these academic "highbrows," and to the normal human reactions to new situations.

As the industrial research laboratory developed, the engineering organizations of industry were also undergoing gradual evolution and change to better meet their new problems. This change was principally due to the entrance into the engineering and manufacturing organizations of formally and basically trained men from our young but increasingly effective schools of technology. As the engineering and manufacturing staffs became peopled with an ever-increasing percentage of men with basic and engineering training, the relations between the industrial research laboratory and the engineering and manufacturing organizations of industry became more cordial and increasingly effective.

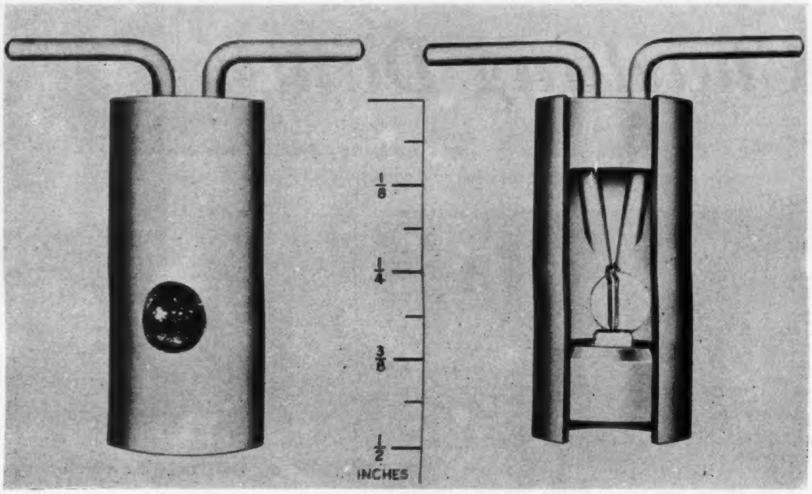
Interesting as is the history of this development, it is not our chief concern tonight. Instead, I shall examine the operations and contributions of the present day "Organized Creative Technology," which is converting scientific knowledge into new tools, materials, and processes with great effectiveness and with an ever-narrowing interval between the incidence of new pure scientific knowledge and the availability of products based upon it. My discussion of "Organized Creative Technology" is based on experience in the research and development organization of the Bell System, and brings out the ordered steps of the process by citing specific developments. In the communication industry, the successive steps no doubt differ in number and in detailed character from those of other industries. However, I believe they are typical of a general pattern for all industry that begins with inspiration from the reservoir of pure scientific knowledge and ends with the complete information for the manufacture of a new product.

In the last century, as has already been pointed out, reliance was placed principally on the individual inventor working with a background of the then state of our basic scientific knowledge to create the completely new products. We have traveled a long way since that time. With the growing scope, complexity, and interrelationships of the different areas of modern science, and the increasing dependence upon them of technology, there is an ever-narrowing opportunity for the individual, free-lance, and traditional "attic-housed" inventor to make significant contribution to progress in "Creative Technology." Organized research teams, staffed with a properly balanced group of highly trained specialists from different areas of science and engineering, contribute an increasing proportion of the new fundamental and technological knowledge and of the inventions that arise from it. The arrangement and composition of these "teams" and the scope of their fields of interest are most important in insuring the maximum of effectivenees of a given group.

Over the years, Bell Telephone Laboratories has experimented with and tried for varying intervals of time different patterns of grouping or organization of the scientists, research and development engineers, and designers who make up the professional staff for "Creative Technology." Out of these years of experimentation with different arrangements and of critical evaluations of their merits and demerits, we have evolved a pattern we consider more effective than any of the others considered. The first step is carried out by a Basic Research organization. Here are placed fundamental scientists and research engineers with their aids. They are grouped according to subject matter into several divisions. Each division covers a clearly defined area of the broad field of science from which advances in the communication technology of interest in Bell System Service may come.

The scientific and research engineering staffs of each division, under the general direction and leadership of a competent research leader responsible to our Director of Research, carry out research programs that dove-tail properly with the forefront of pure science in their area. In carrying out these programs, the research men are not only in intimate contact with the most recent fundamental literature of their field, but also with those carrying out the work, and through their writings and oral presentations they make an important contribution to the new basic knowledge of the area.

We somewhat loosely characterize the work of the organization headed by the Director of Research as "non-programmed work." By this we mean that the work in an area, although in general tailored to the subject matter of that area, is done with freedoms quite similar to those common to pure research in academic institutions. Of course the Director of Research and his research leaders concern themselves with program content. They supply constructive general guidance, determine the proportioning of effort between the different areas, and to an extent the relative emphasis on different aspects of the work within an area. Out of the work of these scientists will come completely new knowledge, principles, and methods that serve as a portion of the reservoir of fundamental knowledge for use in the next step of the chain. Arising in the course of the work, and forming an important part of the contribution of each division are, of course, those creative concepts that constitute "invention." A typical situation may serve as an illustration.



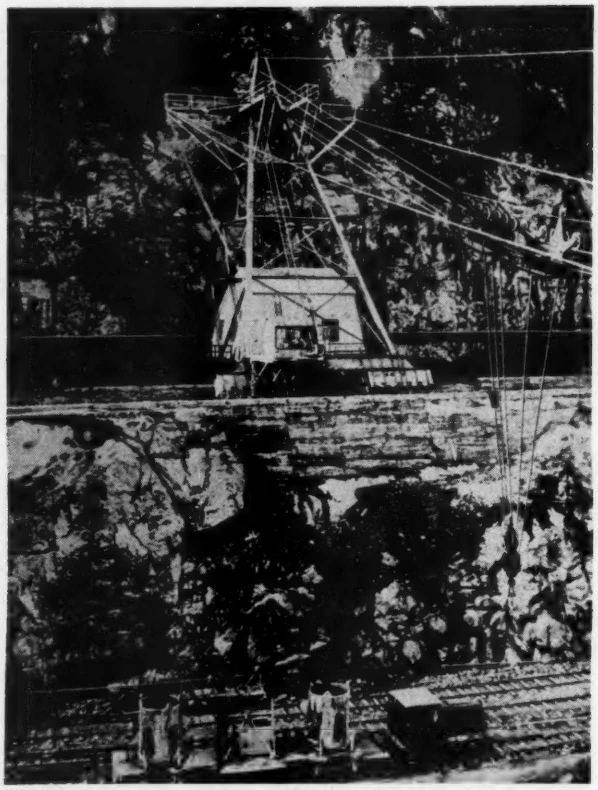
Cut-away view of the Type A Transistor.

"The Solid State" is a subject matter division within our research organization. Under this head, basic research is carried out on such topics as semiconductors, magnetism and magnetic materials, piezo-electricity and piezo-electric crystals, and dielectrics. Those engaged in the program on semiconductors are research physicists, mathematicians, and chemists and their aides. This group, with a full knowledge of the state of pure scientific knowledge of semiconductors and with frequent liaison with those in academic institutions working in this field, initiate and pursue a program of basic research. It has as a

(Continued on Page 25)

Building The Chastang Dam

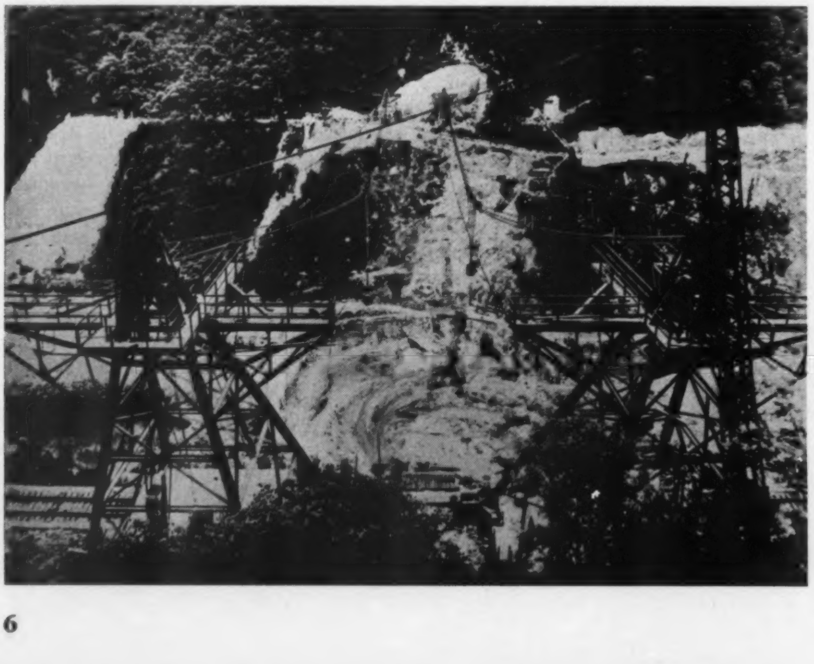
Stanley C. Marshall
Junior Member, WSE
Sauerman Bros., Inc.



Head tower of the 25-ton tautline cableway about to pick loaded concrete bucket off flatcar pulled by diesel-electric locomotive.

Two tautline cableways are expediting the construction of France's great Chastang Dam. The cableways handle the lion's share of materials going into this hydro-electric development—a goodly quantity, too, for Chastang will be second highest in power and third in output of France's more than 300 power dams.

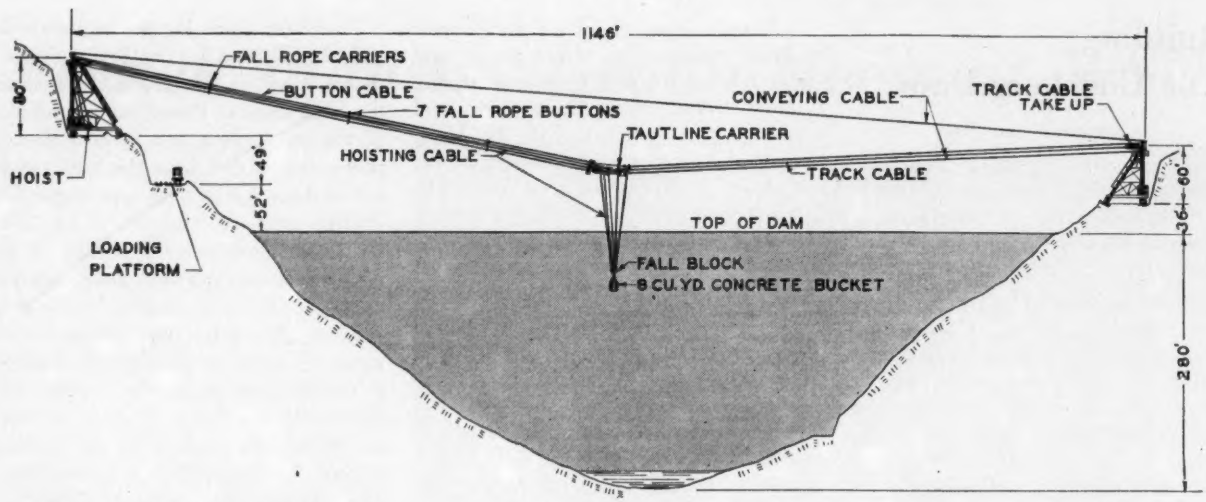
The tail towers of the cableways are 1,146 ft. away from the head towers (foreground). Tail and head towers travel concentric arcs.



The Dordogne River cuts a gorge through the plains of south-central France, in many places through granite to a depth of almost 1,000 ft. and inundating the gorges will be four dams—Bort, Mareges, l'Aigle and Chastang. Fifty-one miles lie between Bort, the upstream dam, and Chastang, the downstream dam, and between dam bases there is a difference in elevation of 500 ft.

Being built under direction of Electricite de France and by Societe General d'Entreprise, Chastang will cut the Dordogne Valley with a length across its crest of 1,145 ft. and height of 280 ft. Of arch-gravity type design, with a radius of curvature of 492 ft. its cross-section through at the base is 75 ft. and at the coping 18 ft.

The long span necessitates relatively thick sections, but the arch-gravity design compensates for this in a measure because it permits a saving of about 25% of concrete used, contrasted with the more conventional types of design.



Above: Cross-section of dam showing cableway installation.

The design also lends itself well to the use of "ski-jump" type spillways, which direct the dam overflow into the air, dissipating its energy. For high discharges this construction is less expensive than canals or long galleries, and further savings have been introduced in the location of the power plant with respect to the downstream curve of the dam, thus shortening the spillways to a minimum.

This type of design adds an interesting complication. Since the overflow runs over the roof of the powerhouse, the latter was designed to support loads of 13.8 tons per sq. yd. on a 72 ft. span. For its construction, 130,000 cu. yds. of pre-stressed reinforced concrete will be used.

The power plant is designed to accommodate three turbo-generator assemblies, arranged so that there are two of the turbo-generator units in one installation and one in the other. Power is obtained from a flow of 71,500 gallons of water through 19 ft. diameter penstocks.

Work began in 1942, and in 1944 the first diversion tunnel was completed. The tunnels, almost 1,000 ft. long, and 535 ft. in cross-section, were dug entirely with hand tools because no others were available. Soon after completion of the first tunnel, the Maquis blew up the field transformers, calling a halt even though the Germans had released men for the work. In 1945, however, both tunnels were completed.

Work preliminary to the actual construction was carried on through 1946

(*Continued on Page* 8)

Below: Twenty-ton steel truss for dam spillway being carried into position. Overhead may be seen carriages of the three cableways on the job.

Building The Chastang Dam

(*Continued from Page* 7)

and 1947, over 290,000 cu. yds. being excavated on the proposed dam site and as preparation for the tautline cableways.

A quarry near Argentat, the operations base, supplies aggregates, which are carried 6.2 miles to Chastang by a bi-cable tramway. A French monocable brings in cement and reinforcing steel from a point on the standard gauge railroad going to Tulle. Two batching plants, one for coarse concrete and one for fine concrete were erected near the cableway platforms, and both plants are fed by the aerial tramways.

After cut-and-fill work was completed, platforms for the tautline cableways were constructed of reinforced concrete doweled into solid rock, with the right bank (looking downstream) platform height set at 101.5 ft. above the proposed crest of the dam. The left bank platform is about 65 ft. lower. Cableway head towers are on the right bank and tail towers on the left.

The two great tautline cableways, manufactured by Sauerman Bros., Inc. of Chicago, are capable of handling maximum hook loads of approximately 25 tons, and operate over spans of 1,146 ft. They are called upon to move 8 cu. yd., bottom discharge, pneumatic concrete buckets, loaded with 32,400 lbs. of plastic concrete; sections of high pressure penstock weighing 20 tons each; machinery; forms and materials going into the dam; and small diesel locomotives.

Self-propelled, and covering the entire range of the construction, they pick up material from any point on a platform below the head towers, and deliver it to any and all points on the dam site. The cableway towers ride tracks laid to concentric curves.

The steel towers are each supported by 24 pairs of double-flanged, heavy duty steel wheels, six pairs being located under each corner of a tower. Horizontal thrust against the towers is counter-acted by battering the head and tail tower front tracks, and monolithic concrete counterweights provide an overturning stability under load of about 125 per cent.

A propulsion motor on each tower drives wheels at one front corner and one rear corner, the propulsion motor, motor brake, silent chain drive and roller chain sprocket shaft all being assembled on a common bed frame, mounted on the tower platform. The propulsion motor is a 75-hp. wound rotor motor, equipped with a Thrustor-type spring set brake.

The head towers, each 80 ft. high, ride tracks on 50 ft. centers, while those for the 60 ft. tail towers are 40 ft. gauge. Running between each pair of head and tail towers is a 3 in. locked coil track cable, with an ultimate strength of 500 tons, and a fully loaded deflection equal to 6.5 per cent of the span.

Riding on each track cable are two six-wheel articulated carriages, operating in tandem. The front of the tandem carriage is provided with a fall rope carrier horn and buffer, used for picking up fall rope carriers which have been spaced out along a button line. The fall rope carriers support the slack of the hoisting and conveying ropes at intervals along the span.

Power for operating the cableways is picked up from a trolley system, mounted on the side of the cliff behind the head towers. Power for propulsion of the tail towers and control circuit cables are carried from the head tower across the gorge by wire rope suspender cables.

Concrete and other materials to be handled by the cableways are picked up from a platform cut out of the rock a short distance below the cableway platform. Concrete is poured into buckets at the batching plants, the buckets riding on 40 ton flatcars, which in turn are pulled into position on the loading plaform by diesel-electric locomotives. The cableway puts an empty bucket on the flatcar, picks up a fresh load, and the empty is returned for refilling. The same procedure is followed for penstock sections, carried by slings; for machinery, carried in skips; and for other materials.

France is eagerly awaiting the dam's completion, for it will be a much needed shot in the arm to up-and-coming French industry.

French Industry Group Meets at WSE

Seventeen representatives of the gray iron foundry industry of France met in the WSE headquarters last month for seminars in conjunction with their tour of the U. S. industrial plants, thus illustrating one of the functions of the Marshall Plan—that of bringing America's technical "know-how" into the battle for greater productivity in Europe.

Congress included in the Foreign Assistance Act of 1948 (the Marshall Plan), a provision for rendering of "technical assistance" to those nations which sought such aid through the Economic Cooperation Administration.

Under the ECA Technical Assistance Program, individual experts and industrial groups have been coming to the United States from all countries participating in the Marshall Plan, to study and observe our industrial practices. Upon return to their native country they undertake to put into practice what they have learned here, in an effort to increase the productivity of their plants, which is deemed essential to the economic recovery of Marshall Plan countries.

Representatives from the British steel foundry industry were the first to come, in February, 1949. Initial arrivals from France represented the heavy electrical machinery manufacturing industry, and just before they returned to France, the "French Gray Iron Foundry group" arrived in New York. A joint conference was held to exchange helpful information and give advice to the new arrivals. In addition, both groups were entertained by the Society of French Engineers in America, and the foundrymen were welcomed by ECA and French Embassy officials in New York.

The French gray iron foundry industry comprises about 850 firms with 900 plants, and a total working force of approximately 40,000. The delegation visiting the United States includes representatives from 13 firms specializing in the production of castings for automobile, machine tool, agricultural machinery and ship-building industries.

The seventeen men in the group include technicians, foremen, and representatives of management, and were chosen by a joint selection committee of the entire industry, which considered nominations from individual companies.

The French gray iron foundry group on the opening day of their program in Chicago. In the picture above, the non-English speaking members of the delegation are wearing ear-phones to receive the French translation of the talks. Elliott Hanson, Chief of the ECA Arrangements Branch, is addressing the group.

Following their New York welcome, the group left for Chicago, WSE headquarters, and a busy schedule.

The program for the foundrymen opened with a reception at WSE headquarters. Speakers, introduced by Elliott S. Hanson, Chief of the Arrangements Branch, ECA, were: George C. Payne, Regional Director, Field Service, Department of Commerce; Jean J. Viala, French Consul General in Chicago; Dr. Gustav Egloff, President, Western Society of Engineers.

Others were: V. D. Seaman, Manager, World Trade Department, Chicago Association of Commerce and Industry, Joseph Sharpe, International Representative, International Moulders and Foundry Workers Union, AFL; Michael Mann, Regional Director, CIO.

The seminar sessions began in the afternoon, with representatives of the American Foundrymen's Society speaking on "An Approach to the American Gray Iron Foundry Industry," and "Some Metallurgical Aspects of the Gray Iron Industry." As with all the sessions, a discussion period followed the talks.

Tuesday, October 4, the group met at the WSE Headquarters for a round table discussion by representatives of the Chicago Foundrymen's Association and the International Moulders and Foundrymen's Union. The subjects covered were personnel relations, foreman-worker relations, worker security and working conditions. In the afternoon the group visited a foundry for observation of the morning's topics.

(*Continued on Page* 10)

Three members of the French delegation watch an American workman as he prepares a mold in the T. L. Arzt Foundry Co. in Chicago.

A seminar on Wednesday morning, October 5, on the subject "Mechanization and Sand and Mold Handling," was conducted by officers of the National Engineering Company, Chicago, and in the afternoon the group visited the plant of the Chicago Hardware Foundry Company in North Chicago.

The group visited the plant of the Moline Malleable Iron Works at St. Charles, Ill., on October 6. L. B. Knight, of L. B. Knight and Associates, Chicago, talked on "Mechanization and Plant Layout," and explained the layout of the Moline plant. In the afternoon the group moved to Elgin, Ill., for a visit to Woodruff & Edwards, Inc.

The Swanson Pattern and Model Works at East Chicago, Ind., was the destination on Friday morning, October 7. In the afternoon the group visited the Accurate Match Plate Company, Chicago.

Saturday, October 8, found the group meeting to discuss the plants seen during the week, and to collaborate on the weekly report.

After a weekend of rest the group assembled on Monday, October 10, in the WSE headquarters, where H. F. Scobie, editor of "American Foundryman," talked on chemical and metallurgical laboratory techniques in the U. S., and Robert P. Schauss, Sales Engineer of Illinois Clay Products Company described the sand laboratory. A visit to the Crane Company foundry in the afternoon completed the day's program.

During the next few days they visited the Wells Manufacturing Co., Skokie, Ill., the Arrow Pattern and Foundry Co., the State Manufacturing & Engraving Co., the Western Foundry Co., and the Whiting Corporation, Harvey, Ill.

They heard talks by representatives of Woodruff & Edwards, Inc., of Elgin, Ill., Arrow Pattern and Foundry Co., the Whiting Corporation, Electro Metallurgical Company of Detroit, Pattern Makers Association of Chicago and Vicinity, Pattern Makers League of North America, and the U.S. Dept. of Labor Apprentice Training Service.

Leaving Chicago, they visited the Allis-Chalmers plant in Milwaukee on October 20, and the foundry of the Falk Corporation, Milwaukee, on October 21.

On the following Monday, the group visited the Hackley Manual Training School in Muskegon, Michigan, and on Tuesday, visited a Muskegon foundry.

Two days were spent at the General Motors Company in Detroit and Pontiac, Michigan, and two days at the Detroit plant of Ford Motor Company.

Moving on to Cleveland, the group visited the Ferro Machine & Foundry Company on November 1; the Superior Foundry Company, November 2; the Osborn Manufacturing Company, November 3; and Grand Industries, Inc. November 4.

Here the group is boarding a chartered bus to transport them to a foundry which they will inspect.

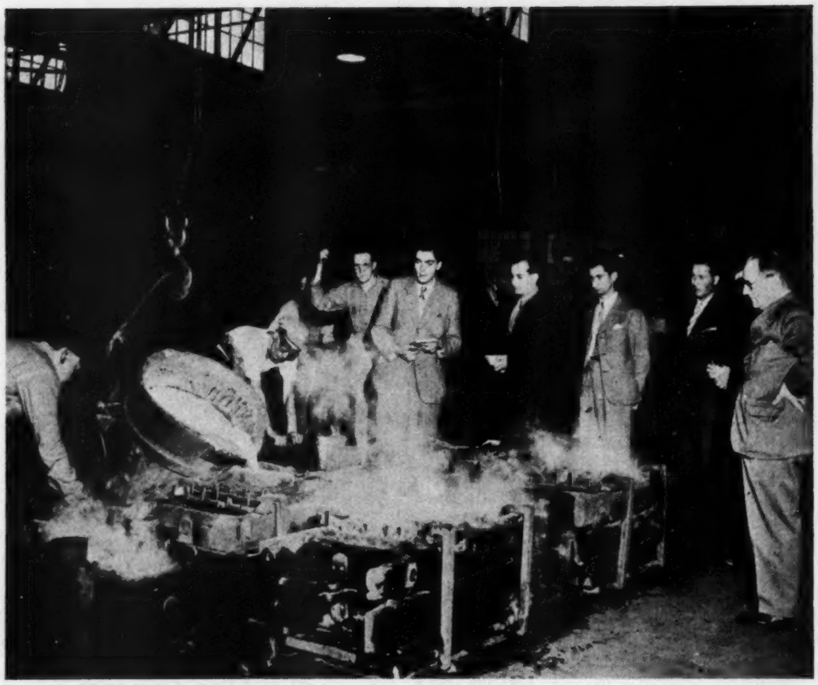
Now, for the first time since their arrival in the country, the group was to visit Washington, D. C., and get a look at the government that was responsible for their trip to the U. S.

They arrived November 5, and after a weekend for group reports and sightseeing, began a schedule of activities that would take them to the French Embassy, National Bureau of Standards, Department of Labor, and the Economic Cooperation Administration headquarters.

The government's role in labor-management in the U. S. would be studied at the Department of Labor, with emphasis on measurement of productivity in industry; research in the fields of cost of living, wages, employment, and working conditions; labor standards; apprenticeship; wage and hour enforcement; and women in industry.

Leaving Washington, the foundrymen will journey to Reading, Pennsylvania, for a tour through The Textile Machine Works, known as "the largest gray iron foundry in the world under one roof." This is a completely mechanized plant.

On November 10 the Frenchmen will move to New York City, for two days of review and discussion of individual reports. They will participate in a press conference and "Voice of America" recording, before departing from International (Idlewild) Airport on November 13, via Air France.



Members of the group watch a pouring operation at a Chicago foundry.

Names of men in the group will be of interest. Paul Chatelin, the group leader, is Technical Administrator and head of the Technical Center of the French Foundry Industry in Paris. Gerard Garnier is engineer and technical director with Chatelet (foundry); Louis Haineaux, is technical director of Haineaux & Co. Charles Haller is president and general director with Bidez and Haller, and Jacques Berlancourt is assistant manager of manufacturing and head of the foundry at Japy Bros.

Others are Rene Brech, Assistant to chief of foundry department with the Mechanical Construction Co. of Alsace, at Mulhouse; Henri Buisset, chief of the foundry and head of production with Cochaux (foundry); Robert Erblane, assistant to the technical director with Lory Bros.; Pierre Lorin, Engineer with FMA (Modern Automobile Foundries).

Each man was asked to specify his particular interests in certain categories of foundry activities, and these served as a guide in arranging the program for the six weeks. The subjects were classified under six headings: management, technical, production methods, production operations, industrial relations, and labor relations.

Details were worked out by the Economic Cooperation Administration.

While the team is in the U. S. it is the guest of ECA, with expenses being provided from ECA funds, pending settlement with the government and industry involved.

A French foreman examines a core being prepared for baking in one of the ovens at the T. L. Arzt Foundry Co., Chicago.

WSE Dinner Guests Hear Photo Officer

More than 500 WSE members and guests attending the Annual Fall Dinner, October 31, heard Col. George Goddard of Wright Field describe the early history of aerial photography, and demonstrate the latest development — stereoscopic-strip photography.

These pictures showed the great value of this type of photography for military reconnaissance, and illustrated the motion-stopping ability of this photographic system. It allows the taking of sharp photographs in color from low-flying high-speed aircraft where orthodox photography would yield nothing but a blur.

Special equipment for the stereoscopic system was invented by Fred T. Sonne, and developed and manufactured by the Chicago Aerial Survey Company, of which he is Vice President and Chief Engineer.

An unusually large aerial camera is employed, containing one roll of film 9½ inches wide and 200 ft. long. The film moves past a narrow slit in the camera which acts as a shutter during exposure, the movement of the film corresponding with the ground speed of the plane to prevent any blurring.

The stereoscopic-strip camera has two lenses which record slightly different aspects of the scene side-by-side on the film strip. When projected by a special polarizing projector, the audience sees a "three-dimensional" picture.

Guest Cards Available For Wives, Daughters

Guest cards, for the use of wives and adult daughters of members, have now been made available by the Western Society of Engineers, and may be obtained by request at WSE headquarters, 84 E. Randolph Street.

Cards will be issued in the name of the wives or daughters desiring them, and WSE extends an invitation for the use of the dining room and lounge for lunch or dinner, and for rest and refreshments while shopping.

WSE wives will like the comfortable and attractive decor, and the friendly welcome that is extended.

Make a date now to meet some of *your* friends at WSE Headquarters before your Christmas shopping tours.

WSE Women's Council News

Miss Clara Lawrence

One of the most active members of WSE's Women's Council was saluted by the Princess Pat program, "An Orchid to You," on October 6 over Station WNMP, Evanston.

She is Miss Clara Lawrence, Corporate Secretary and Treasurer of Wm. B. Lucke, Inc., Wilmette.

Cited for achievements in behalf of all women, her activities were described by the announcer as follows:

"During this present week, our country is observing 'National Employ the Physically Handicapped Week.' Miss Lawrence was appointed a member of President Truman's Committee to handle this problem. She has done a great deal toward making the aims of this committee materialize. But Miss Lawrence's service on President Truman's committee is just one of the many projects that she has so ably helped to complete successfully."

Among the activities mentioned were her help in the founding of the Celia Howard Fellowship Fund, which sponsors an Illinois woman doing graduate study in the field of diplomatic service in the U. S. or in foreign countries. As president of the Illinois Federation of Business and Professional Women's Clubs, she was able to make this long-dreamed-of fellowship a reality. As president of the Federation, she also worked untiringly in behalf of the Women's Equal Pay Bill, and was a delegate to the International Conference of the Clubs in Paris in 1947.

She is president of the Women's Share in Public Service, an organization made up of twenty-five women's groups—local, state, and national. They represent one and one-half million women who are interested in promoting qualified women for public office.

* * *

Advice on building a house will come straight from the drafting table of Miss Ruth Perkins, architect, associated with Bertram A. Weber, also problems of—and with—the hopeful home owner.

Miss Perkins, a W.S.E. member, will speak at the November 9 meeting of the Professional Women's Council of W.S.E. Those who wish to have a pre-meeting get-together will meet for dinner in our dining room around 5:30 p.m. The meeting will be called to order at 7:30 p.m. All members of W.S.E. are welcome.

* * *

The Women's Council had as its guest for dinner and round table discussion Miss Ellison Harvie, architect from Australia, Wednesday evening, October 26th.

Miss Harvie, a member of the firm of Stevenson, Turner and Harvie, Architects of Melbourne aad Sidney, stopped in Chicago on her way home from a year's study and observation in Europe and the U. S. She is primarily interested in design of hospitals and schools.

It was very interesting to hear Miss Harvie tell of the advances being made in hospital and school design abroad and here at home. She seemed very glad to have a chance to meet and exchange ideas with a group of women architects and engineers such as we have in the W.S.E. Professional Women's Council.

* * *

EXTRA! The Professional Women's Council's Constitution and By-Laws have been approved by the Board of Western Society of Engineers. O. K. members, let's get those twenty new members and make it a regular Professional Women's DIVISION by spring!

How Western Society Serves Its Members

Dr. Gustav Egloff, President
Western Society of Engineers
Universal Oil Products Company

Presented before the annual meeting of the Engineering Council for Professional Development, October 28, 1949, Edgewater Beach Hotel, Chicago.

The Western Society of Engineers, founded in 1869, was the fourth engineering Society to be established in the United States. Its first president was Col. Roswell B. Mason who was elected Mayor of Chicago in the same year and served in the latter capacity during the great fire of 1871. The Society's roster includes engineers from all branches of the profession. Although headquarters are in Chicago and most of its members reside in that area, the Society has nonresident members in every section of the United States and many foreign countries. It is unique among engineering societies and has much to offer engineers of all age brackets from students to men having long records of accomplishment.

The Western Society is so organized that it fulfills five fundamental needs of the engineering profession by encouraging the advancement of:

(1) The theory and practice of engineering
(2) The interests of the profession
(3) The education of its members
(4) The interests of the community
(5) The interests of the employer

For the purpose of advancing the theory and practice of engineering, the Society has ten sections, representing different interests, which meet to present and discuss technical subjects. There is at least one such meeting each week from October to June. The sections include:

(1) Bridge and Structural Engineering
(2) Chemical and Metallurgical Engineering
(3) Communications Engineering
(4) Electrical Engineering
(5) Fire Protection and Safety Engineering
(6) Gas, Fuels and Combustion Engineering
(7) Hydraulic, Sanitary and Municipal Engineering
(8) Mechanical Engineering
(9) Traffic Engineering and City Planning
(10) Transportation Engineering

The professional interests of Western Society members are served through many committees and the operations of four divisions: (1) Consulting Engineers (2) Engineering History (3) Junior Division and (4) Professional Women's Council. In a long term program for the advancement of engineering as a profession, the Junior Division is of particular importance. This division stems from the recognition by the Society that it has a primary obligation to aid the young graduate in becoming adjusted to his position in the scheme of things. In the development of an engineering career, the value of a professional society cannot be overemphasized. An engineering society can offer the young graduate an opportunity both to keep his technical knowledge up-to-date and to make professional contacts. Participation in society activities also gives him a sense of belonging to the profession, and as a corollary, imbues him with a professional pride. The Junior Division of the Western Society is unusually worthwhile in this respect, inasmuch as it provides for greater opportunity for self-expression and for more active participation by the younger member than would otherwise be possible.

Professional interest must also be stimulated by good publications. The Western Society has such a medium in its official journal, *The Midwest Engineer*, which is published monthly from September through May. The articles included are concerned with subjects of broad engineering interest. News of Society activities keeps the members in close touch with the work going on. Future meetings are announced and past meetings are reported upon both pictorially and in print.

(*Continued on Page* 14)

How Western Society Serves Its Members

(*Continued from Page* 13)

To provide incentives for creative work, WSE presents two awards: the Octave Chanute Medal to a member for a paper in the field of civil, mechanical or electrical engineering; and the Charles Ellet Award, to a Junior member for an outstanding paper.

WSE also participates with the four Founder Societies in the Alfred Noble Prize for excellence of technical papers, and the Washington Award, which recognizes preeminent service in advancing human progress.

The Western Society provides a direct service to its members in the formulation of programs for post-collegiate training. More often than not, engineers find that they must continue with some schooling in order to attain real success and recognition. For this purpose, the Educational Committee has worked with high-grade engineering schools in the Chicago area to make appropriate night classes available.

For some time the Western Society has sponsored a refresher course at the Extension Division of the University of Illinois to assist its members in preparing for the State Professional Engineering examinations, which are prerequisite to the granting of a Certificate of Registration.

New Educational Program

A new educational program is now being worked out to remedy recognized short-comings of the average engineering education. The criticism most often directed at engineers is that they know too much of engineering, science, and mathematics, and too little of writing, speaking, economics and cultural subjects. The Society believes that the engineer must have an understanding of the contemporary world and its inhabitants in order to utilize his technical skill to the advantage of society and himself. He must be able to express his ideas to others and understand how these ideas fit into the general economic picture. It is indeed difficult for the engineer to acquire all of the background he needs in non-scientific studies during college. He has necessarily devoted a great portion of his time in school to an acquisition of knowledge of the natural laws which are basic to his profession. For these reasons the Western Society is making it possible for the engineer to supplement his knowledge in other fields after leaving school.

The slogan for this new General Education Program is "Thinking, Reading, Speaking, Writing." Unless the engineer has developed these talents and can communicate his ideas in a coherent report to superiors and co-workers, they are not of much use to mankind nor to his employer. The engineer as a business man must also carry on some correspondence and frequently write articles for technical publications. He often addresses technical meetings, and if he has civic interest truly at heart, will speak before lay groups to acquaint them with the part engineering plays in their lives. To prepare the engineer to these responsibilities, the Western Society will include in the program, courses which cover effective business English, advanced letter writing, report writing, public speaking, public relations, and editing.

In addition to being scientifically sound, good engineering must fit into the general economic pattern, but not many engineers have had the time nor the inclination to take courses in economics during their formal education. After they have stumbled over a few problems in the workaday world, the need for such background becomes evident. The Western Society will, therefore, sponsor two courses in economics, one general and the other in systems of political economy. Among the subjects included in the general course will be functions and processes of economic systems, population and natural resources, methods of financing, money standards and systems, the problem of business depressions, price structures, market control policies, the distribution of income, government financial policies and a study of capitalism and collectivism.

As the engineer makes professional advancement, he is very likely to become involved in labor relations problems. If he is well grounded in the past history of the labor movement and the present theories and practices, he stands a much better chance of coping with these problems. A course, which the Western Society plans to sponsor, will cover the development of the American labor movement, elements of collective bargaining, a study of labor relations, and a study of human relations factors and supervision.

The engineer also needs to understand political science rather thoroughly, not only in the interests of being an all-around good citizen, but for the reason that many statutes have direct bearing on engineering work. Two political science courses will be offered. The first will cover the development of American political institutions and the second will be a study of the laws on engineering, property, and taxation.

Serves Civic Committee

The Western Society serves the civic interests of the community in a number of ways. The Civic committee keeps constant vigilance over civic affairs relevant to engineering. Examples of matters studied by the various subcommittees are civil service operations, registration laws, smoke abatement, building codes, and traffic problems. They are deeply concerned with all engineering problems which affect the health, operation and beauty of the City. As an engineering society of recognized high standing, Western is frequently asked to furnish members for committees of the City and State on public engineering problems. For example, a number of Western Society members are on the City Planning Commission. Members are also working on the Sag-Calumet Navigation Project which is laying plans to make the Calumet river navigable for barges.

The activities of the Western Society are also of high value to the employer of engineers. Keeping in touch with technical advances and engineering activities is a must for any company that wishes to survive. Personal contacts made at the Society are tangible factors in increasing sales and maintaining business relations. Society participation also increases morale among engineering employees. All concerned benefit from the broadening influence of contact with leading engineers whom the employee meets at Western Society headquarters.

Every purpose of the Society is served by the opening of the new Western Society headquarters early this year. It is one of the most outstanding projects in the progressive program of expanded service to the engineering and scientific professions. It is, furthermore, an important step toward the creation of an engineering and science center for the city of Chicago. These new quarters are appropriately located in the building adjacent to John Crerar Library which has an outstanding collection of technical information. Other scientific and technical groups are also locating in these buildings.

The quarters of the Western Society occupy three floors totalling about 9000 sq. ft. of space. The dining room, located on the fifth floor, seats 135 people and is open five days a week for lunch and dinner and by special arrangement at other times. It accommodates the dinner meetings of a number of scientific and technical Societies and other groups.

The sixth floor includes a lounge, bar, check-room, and staff offices. The lounge is beautifully appointed and comfortable. It serves as a gathering place for groups who are holding dinners or programs in the quarters, and its central location makes it an ideal meeting place for engineers and their families. In short, the engineers of Chicago now have a home in the loop.

On the floor above, an auditorium and other meeting rooms are provided. The auditorium is acoustically treated and well-lighted, is equipped with modern public address and picture projection systems which permit varied and effective program presentation. It is indeed a far cry from the usual hotel banquet room where acoustics are poor and someone's head is constantly bobbing up between the screen and slide projector. There are 200 comfortable theater-type seats in the auditorium and seating capacity can be increased to 300 by using the adjoining room. Otherwise this room can be used separately by a second group having 100 or less in attendance. A small conference room, suitable for a group of 20, is also located on this floor.

At present, about 45 groups are making use of the headquarters facilities. These include such societies as the American Institute of Electrical Engineers, American Society of Tool Engineers, American Institute of Chemists, Society for the Advancement of Management, Illinois Institute of Technology Alumni, U. S. Naval Academy Alumni, and the American-Swiss Chamber of Commerce. Appropriate meeting places for these societies have been scarce and expensive, and the Western Society is pleased that it can offer such service to other societies.

The quarters were leased for five years and are expected to be the home of the Western Society for some time to come. They required a cash outlay of $120,000 which was contributed by members, their employers and a number of industries. The entire project, however, represents about $200,000 in work and materials. The remaining $80,000 was donated in the form of architectural, engineering and other services. The Society is more than pleased to report that the entire project has been paid for.

The quarters are, however, only the first step toward the goal of a full scale Engineering and Science Center. Ultimately a Center will be built which will offer complete facilities to all professional groups both large and small. Plans are to incorporate under one roof a large auditorium seating thousands, meeting rooms of various sizes, office quarters for various societies, restaurant, lounge, club room facilities, reading rooms, and the John Crerar Library. It will provide the professional people of Chicago with a meeting place where they may reap the full benefits of close association with each other. The building should also attract the National meetings of many engineering and scientific societies to Chicago, inasmuch as it will provide ideal quarters for such conventions. The proposed Center will be looked upon as a great civic service to the city of Chicago, one of the world's focal points of engineering activity and education.

ANNOUNCE COMPETITION FOR CHARLES ELLET AWARD OPEN TO JUNIORS

Members of the Junior Division are eligible to compete for the annual Charles Ellet Award for the best semi-technical paper presented before WSE members.

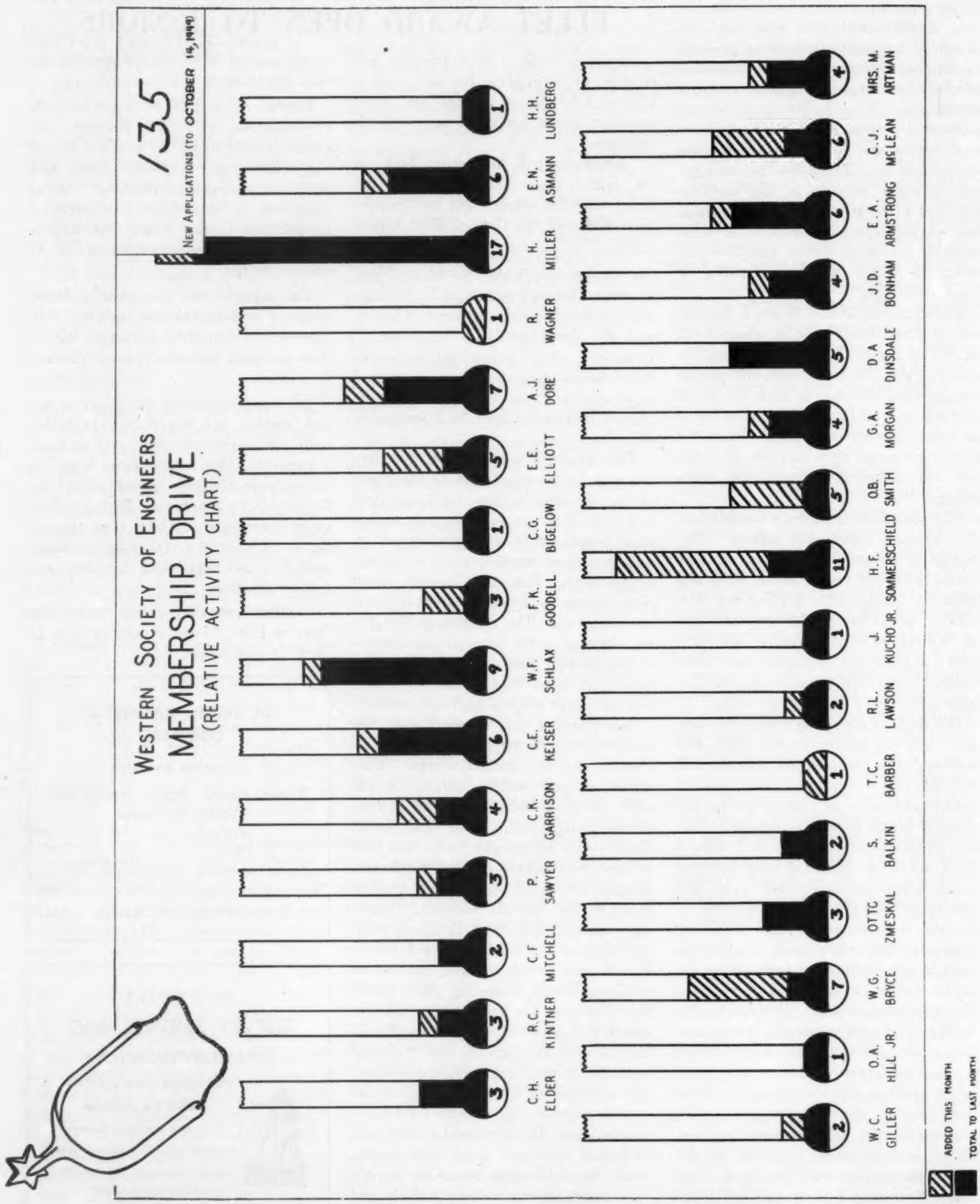
Contestants will be judged both on the written paper and on the oral delivery, and the winner will be formally presented with the Charles Ellet Award at the annual WSE dinner meeting on May 29, 1950.

Established in 1929 by a gift from E. C. Schuman, a Junior member, the award is symbolized by a silver loving cup with each recipient's name and alma mater engraved thereon. This is displayed in the WSE headquarters. In addition to this honor, the winner receives $25.00 and an engraved Certificate of Award.

The paper should present a lay-treatment of a semi-technical subject. Objective but complete coverage, rather than complex formulæ and derivations, is desired.

All Junior members (28 years of age and under) are urged to file notice with the secretary's office and prepare a paper for this competition. Intention to compete for this award should be forwarded to the Junior Division Program Committee not later than December 1, 1949, so as to facilitate necessary publicity and scheduling for the competitive meeting.

Further inquiries concerning the Charles Ellet Award should be sent to WSE Headquarters.



Western Society of Engineers
Membership Drive
(Relative Activity Chart)
135
New Applications (to October 14, 1949)
C.H. Elder 3
R.C. Kintner 3
C.F. Mitchell 2
P. Sawyer 3
C.K. Garrison 4
C.E. Keiser 6
W.F. Schlax 9
F.K. Goodell 3
C.G. Bigelow 1
E.E. Elliott 5
A.J. Dore 7
R. Wagner 1
H. Miller 17
E.N. Asmann 6
H.H. Lundberg 1
W.C. Giller 2
O.A. Hill Jr. 1
W.G. Bryce 7
Otto Zmeskal 3
S. Balkin 2
T.C. Barber 1
R.L. Lawson 2
J. Kucho Jr. 1
H.F. Sommerschield 11
O.B. Smith 5
G.A. Morgan 4
D.A. Dinsdale 5
J.D. Bonham 4
E.A. Armstrong 6
C.J. McLean 6
Mrs. M. Artman 4
Added this month
Total to last month

These men have won their Spurs---

BY OBTAINING AT LEAST ONE NEW MEMBER

Anderson, Bolton G.
Artman, Mrs. M. E.
Bailey, G. G.
Balkin, S. F.
Becker, Donald N.
Bernhard, Leroy F.
Burt, George H.*
Buxton, B. L.
Carlson, A. C.*
Carlson, W. W.*
Culp, E. R.
Dartsch, F. A. L.
Davies, F. C.
DeLeuw, C. E.
DeWolfe, E. C.

Egloff, Gustav
Elder, Clarence H.
Elliott, E. E.
Fischer, David J.*
Fredrick, T. C.
Gabbard, L. C.
Graham, I. E.*
Gray, Walter*
Guthrie, R. M.
Halperin, Herman*
Hanson, C. D.
Hecht, J. L.
Herr, C. C.*
Horneman, Miss B.*
Humiston, J. F.*

Jackson, A. L.
Jelinek, O. K.
Kahler, W. V.
Kawiecki, C. J.
Keith, A. W.
Kelly, R. R.
Kerr, A.
Kucho, Joseph
LeClair, Titus G.
Lockwood, L. E.
McKee, K. E.*
McLean, C. J.*
Maney, F.*
March, Edward J.
Marston, W. R.*

Mee, C. L.
Melnick, T.
Michaels, E. E.
Miller, Herbert R.
Murphy, Miss M. L.
Perkins, Miss R.
Peterson, Ralph S.*
Randall, Edwin A.
Ruzich, J. L.*
St. Germain, A.*
Salzman, A. L.*
Sargent, Ralph
Saunders, N. H.

Sawyer, Percy
Schick, N.
Schirmer, R. W.*
Schoonover, Howard*
Schmitz, C. E.
Sedwick, H. P.
Seymour, C. W.*
Simpson, G. N.*
Skog, L.
Smith, D.L.*
Smith, F. C.*
Smith, O. G.*
Sommerschield, H. F.*
Strazz, A. J.
Sykes, Wilfred

Taylor, O. H.
Tornquist, E. L.
Tuttle, L. W.
Vanderkolk, W. W.
Wade, J. William
Walker, C. W.*
Weeks, L. E.
Whiting, F.
Wier, R. J.
Wilkins, D. C.
Williams, Kenneth
Williams, G. M.*
Wisner, G. F., Jr.*
Wolfe, Thomas
Woloshin, Boris*

* Since last period

Ride 'em, Cowboy!

MECHANICAL ENGINEERS

To Hear 270 Speakers During National Meeting in New York This Month

With more than 270 speakers drawn from university, laboratory and every phase of industry scheduled to deliver some 200 papers, the 70th annual meeting of The American Society of Mechanical Engineers in New York, Nov. 28—Dec. 2, will be one of the most comprehensive ever offered by the society. Dedicated to the hope that the contributions of technology may be used to further a peaceful world, it is expected that the meeting will attract upwards of 6,000 engineers from all parts of the country. Headquarters will be the Statler Hotel.

The theme of the meeting will be developed at 78 technical sessions sponsored by 22 professional divisions and committees of ASME. Prominent figures in engineering, industry and public life will speak at 16 dinners and luncheons.

Fields to be Covered

Fields to be covered are: power, aviation, applied mechanics, fuels, gas turbines, heat transfer, hydraulics, industrial instruments and regulators, machine design, management, materials handling, metals engineering, oil and gas power, process industries, production engineering, railroad, rubber and plastics, textile, wood industries, petroleum.

James M. Todd, president of the ASME, will deliver the presidential address at the annual dinner on "Honors Night," Wednesday, Nov. 30. He will be preceded on the speaker's rostrum by Dr. H. J. Gough, president of the Institution of Mechanical Engineers of Great Britain. Indicative of increasing efforts of engineers here and abroad in encouraging the exchange of information, his topic will be "May We Cooperate." The society's annual awards will be conferred at this occasion and fifty-year members will be honored. President-elect James D. Cunningham, president of Republic Flow Meters Co., and a member of WSE, who will take office at the close of the convention, will be introduced.

Dr. Lillian M. Gilbreth, outstanding woman engineer, will address the President's Luncheon on the opening day. Dr. Gilbreth is noted for time and motion studies which she began with her husband, the late Major Frank B. Gilbreth. She adapted principles of industrial management to the home in raising her family of 12 children, two of whom, Ernestine Gilbreth Carey and Frank B. Gilbreth, are the authors of the best seller, "Cheaper by the Dozen."

Five sessions will be conducted by the Management Division. The sessions will consist of symposia on the obligation of management to create a better industrial life, to control costs, create quality, improve distribution, and the obligations imposed by trusteeship. In addition, there will be a management luncheon on Wednesday, Nov. 30. The speaker will be Frederick S. Blackall, Jr., president and treasurer of the Taft-Peirce Manufacturing Co., Woonsocket, R. I., whose topic will be "The Obligation of Management to Provide Leadership."

Hugh L. Dryden, director of aeronautical research for the National Advisory Committee for Aeronautics, will address a luncheon of the Industrial Instruments and Regulators Division on Tuesday, Nov. 29. F. C. Hottel, of the Massachusetts Institute of Technology, will speak on "Uses of Solar Radiation," at a luncheon of the Heat Transfer division, the same day.

The first of a lecture series established as a memorial to the late Roy V. Wright, for a long time vice president, secretary and director of the Simmons-Boardman Publishing Corp., will be delivered by Judge Arthur Vanderbilt of the Supreme Court of New Jersey, on Tuesday, Nov. 29. He will talk on "Standards for Citizenship."

A symposium on air cargo transport on Tuesday, Nov. 29, will be co-sponsored with ASME by the Institute of Aeronautical Sciences and the Society of Automotive Engineers. Improvements in air cargo ground handling, possible methods of improving cargo aircraft, future requirements of military air cargo and planning for the air cargo terminal are among the phases which will be discussed by officials of civilian airlines and military transport.

Other Subjects

Other symposia will include: employment prospects in 1950 for the junior engineer; fly-ash utilization; railroads as our largest materials handling industry; attracting mechanical engineering graduates to the railroad industry.

Advances in plastics 1948-49 will be reported on Tuesday morning by J. D. Falcon, application engineer, plastics division, General Electric Company, Pittsfield, Mass., while Lois Brock, technical librarian, G. H. Swart, director of research, and E. V. Osberg, sales executive, the General Tire and Rubber Company, Akron, O., will present a paper Tuesday afternoon on advances in rubber in 1948-49.

Paul C. Aebersold, chief of the isotopes division, Oak Ridge Operations, United States Atomic Energy Commission, Oak Ridge, Tenn., will discuss

"Isotopes as Tools of Engineering," Thursday morning, Dec. 1. At the same session, George G. Manov, chief of the advisory field service branch, and D. O. Lintz, health physicist of the same division, will present a paper entitled, "Safe Handling of Isotopes."

Other special events will include:

Fuels luncheon, Wednesday, Nov. 30; speaker, Richard Harkness, Washington correspondent for the National Broadcasting Company, "Behind the Scenes in Washington."

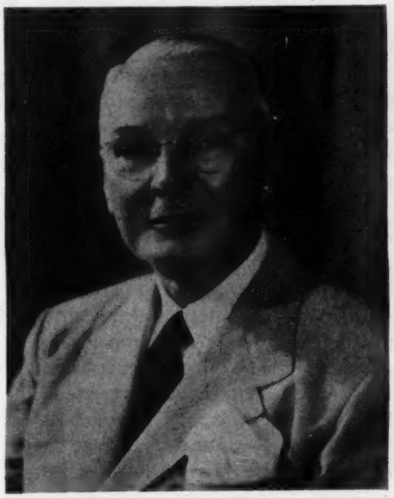
Machine Design luncheon, Thursday, Dec. 1; speaker, Tell Berna, general manager, National Machine Tool Builders Association, Cleveland, "Developments in the Machine Tool Industry."

Materials Handling luncheon, Thursday, Dec. 1; speaker, R. C. Sollenberger, executive secretary, Conveyor Equipment Manufacturers Association, Washington, D. C.

Other events for which speakers are not yet announced will include: hydraulic old-timers' dinner, Tuesday; members' and students' luncheon, Thursday; textile luncheon, Friday.

James D. Cunningham Elected ASME President for 1950

The election of James D. Cunningham as the national president of The American Society of Mechanical Engineers for 1950, has been announced by the society. He is president of Republic Flow Meters Company and has been a member of Western Society of Engineers since 1920.



James D. Cunningham

He will take office at the end of the 1949 Annual Meeting, to be held in New York, Nov. 27 to Dec. 2, and will succeed James M. Todd, consulting engineer of New Orleans, as president.

Nominations were made last June, and national letter balloting by the membership, which numbers over 30,000 engineers, closed in September.

A Chicagoan since birth, Mr. Cunningham's civic contributions are many and noteworthy and his rise in industry has been spectacular.

He was born May 5, 1887. After graduation from Hyde Park High School in 1905, he entered the employ of Armour and Company, where he remained until 1909. He then purchased an interest in the Clyde Machine Works of Chicago, leaving there in 1911 to incorporate the Steam Appliance Company, later changing its name to Republic Flow Meters Co., and serving as President since its inception.

Mr. Cunningham's interest in educational work is manifested in his Chairmanship of Illinois Institute of Technology, which position he has occupied since 1933. Illinois Institute of Technology is now one of the leading technical schools in the country. In 1944 Mr. Cunningham was awarded the honorary degree of Doctor of Engineering.

He is a member of the Western Society of Engineers; member of the Board of Managers of Presbyterian Hospital; a Past President and now a member of the Advisory Board of Illinois Manufacturers' Association and a Director of Blue Cross Plan for Hospital Care.

Mr. Cunningham serves as a Director on the boards of Allis-Chalmers Manufacturing Company, Baltimore and Ohio Railroad Company, Belden Manufacturing Company, Lake Shore National Bank, Lumbermens Mutual Casualty Company and Associated Companies and Public Service Company of Northern Illinois.

CRERAR LIBRARY Notes and News

For the information of members of the Western Society of Engineers, this month's column is devoted to the description of the *Technology Department* of The John Crerar Library and the facilities and services which it offers for engineering research.

The *Technology Department* serves engineers and other professional personnel requiring the literature of chemistry, physics, geology, and other natural sciences and their applications in engineering and the other technologies. The strength of these collections is indicated by the fact that the library has some 55,000 volumes in engineering, 40,000 volumes in chemistry, and comparable collections in other related scientific subjects. Current and historical files of scientific journals, both foreign and domestic, are unique for their range and completeness.

Guides to these collections are provided by the library's catalogs and by the special indexes to published technical literature. The latter include the current card service, as well as the annual volumes, of *Engineering Index.*

There are also many special subject indexes. Most engineers know of *Chemical Abstracts,* which indexes chemical literature in some 4300 periodicals. Others not so widely known, but often of importance to the specialist are:

Science Abstracts (A. Physics; B. Electrical Engineering)
British Abstracts (Chemistry)
Refrigeration Abstracts
Textile Technology Digest
Electronic Engineering Master Index
Applied Mechanics Review
Metallurgical Abstracts
Metals Review (ASM)
Building Science Abstracts
Abstract Bulletin, Aluminum Laboratories, Ltd.
Nuclear Science Abstracts

A technically trained staff of reference librarians, under Mr. H. Einar Mose, Chief of the *Technology Department,* assists in the use of catalogs and indexes, in locating particular books or journals, and in searching out other sources of information for the engineer.

WSE Personalities in the News

A prominent professional engineer and member of W.S.E. advises students of Illinois Institute of Technology to develop the art of self expression.

Charles E. Burdick, of the firm of Alvord, Burdick and Howson, consulting engineers, told the college chapter of the American Society of Civil Engineers that "an incoherent engineer is doomed to a minor position."

In many cases the ability of expression, oral or written, is a gift of inheritance, he said.

"But whether inherited or acquired, the art of expression can be improved by study, example and practice.

"Anything written, if useful, has one purpose—to convey an idea. And," he emphasized, "there is no idea so complicated that it cannot be expressed in relatively few simple words providing the engineer understands the idea himself.

"As in other walks of life, engineers succeed on the basis of character, personality, knowledge, and above all—the ability to express ideas clearly and logically."

* * *

Daniel R. Fulton has recently joined the Roots-Connersville Blower Corporation, Chicago Sales Office, in the position of Field Engineer, according to D. A. Johann, District Manager of the firm, and a member of WSE.

Mr. Fulton is a graduate of Northwestern University and has just completed a sales engineering training course at the company's headquarters in Connersville, Ind.

Dr. Gustav Egloff, WSE president, addressed members and guests of the American Institute of Chemists, Chicago Chapter, when the Institute presented its Honor Scroll Award to Dr. Otto Eisenschiml October 7.

Dr. Eisenschiml, who spoke before Western Society of Engineers October 17, is president of the Scientific Oil Compounding Company, Chicago.

Six speakers covered various aspects of Dr. Eisenschiml's career, Dr. Egloff's topic being, "Otto Eisenschiml, the Chemist." The general theme of the meeting was the recognition of the many chemists who are reponsible for modern miracles in science and industry, but whose names are practically unknown to the man in the street.

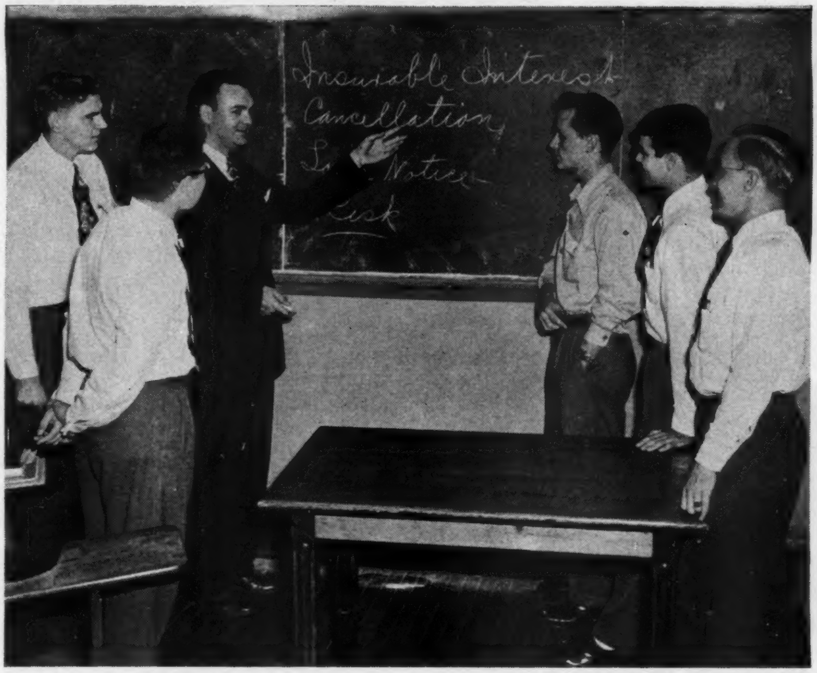
On October 17, Dr. Egloff addressed the Chicago Oil Men's Club on the subject, "The Oil Industry and Some of Its Products." Dr. Egloff told the group that the favorable attitude of the petroleum industry toward research has set an example for other industries.

"The results of its programs have proved to others that research is vital to a growing industry and have encouraged them to join in the progressive trend," he said.

He predicted continued widespread exploration for new crude oil reserves in the United States as he attacked those who predict only a handful of years left for crude production.

* * *

C. A. Gaensslen is retiring after 37 years with the Bridge Division of the City of Chicago. A member of Western Society of Engineers, he will remain in the Chicago area.



Prof. John J. Ahern lectures to students in new property insurance course being given at Illinois Institute of Technology.

Ahern of I.I.T. Begins Property Insurance Class

A new concept of education for property insurance men, has been developed by Illinois Institute of Technology, in cooperation with the Western Underwriters' Association.

The two-year program is under the direction of the Department of Fire Protection and Safety Engineering, headed by Prof. John J. Ahern, a WSE member, and the Department of Business and Economics, headed by Prof. Pearce Davis.

A certificate in property insurance will be presented to students completing the 49 hour curriculum, which combines fire protection and safety engineering training with courses in insurance, management, economics, mathematics, English, and public speaking.

Persons completing the curriculum may apply the required 49 credit hours toward a bachelor's degree in business and economics if they wish to continue their education.

Courses are scheduled between 8 a.m. and noon. In the afternoon, students will work in the offices of their respective sponsoring companies. In exchange for tuition and salary, the students agree to continue with the company for at least two years after receiving the certificate in property insurance.

Twenty scholarships for the curriculum have been awarded by member companies of the Western Underwriters' Association, beginning with the present semester.

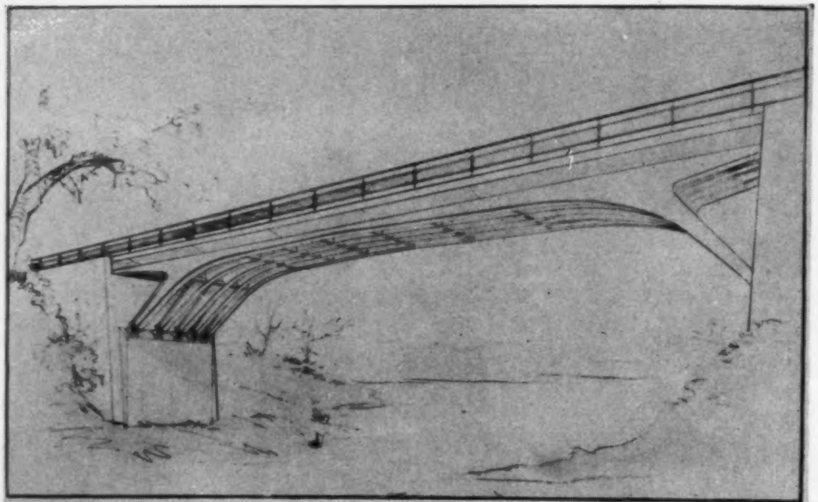
Advertisers In This Issue

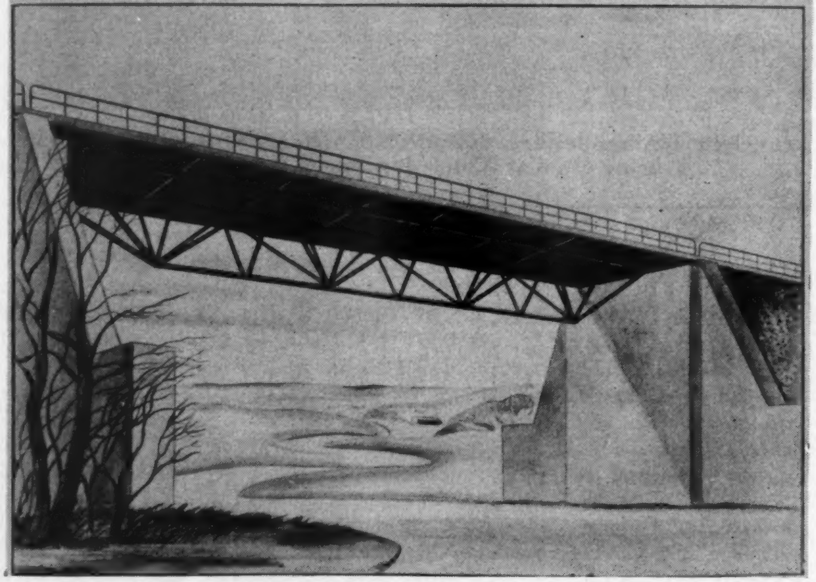
Announce Welded Bridge Awards

"Bridges don't fly but bridge builders nevertheless can take a note from the boards of airplane designers." This was the comment of a member of the Jury of Award in announcing the results of the Lincoln Arc Welding Foundation's award program, "Welded Bridges of the Future."

Announced today were awards totaling $6250 to bridge designers for the best designs of a two-lane, 120 ft. deck highway bridge of all welded construction and utilizing where necessary the designer's ideas for new steel shapes that could readily be produced for the more efficient use of steel. The program was sponsored by the Lincoln Foundation of Cleveland, Ohio to offer an incentive to engineers to design bridges especially for welded fabrication and to explore the future of bridge design with thinking not bound to the restrictions of tradition that now limit work in this field.

The future bridge designs, submitted from 25 different states, were clearly influenced by the type of structural engineering that has created the modern airplane. The successful welding of strong rigid airplane frames has suggested to bridge designers a typical bridge of the future which is a solid single unit more like a machine or automobile frame, instead of a structure built up by bolting or riveting one piece to another. The welded bridges of the future will be lighter, stronger, and less expensive.





An artist's conception of two of the award designs recently announced by the Lincoln Foundation for its "Welded Bridges of the Future" program.

Lower design received the first award of $3,000. Top design, Honorable Mention. Photo, courtesy of The James F. Lincoln Arc Welding Foundation.

The $3000 First Award went to Thomas C. Kavanagh, a professor of civil engineering at Pennsylvania State College, State College, Pennsylvania. The winning design uses a compact triangular shaped steel frame to support the bridge roadway. Taking advantage of two new steel shapes, devised by the designer, as well as the economy and facility of welded joints, the airplane-like frame results in a simplified lightweight, low cost bridge of graceful and slender appearance.

The Second Award of $1500 was received by Angel R. Lazaro, Jr., Malabon, Rizal, Republic of the Philippines. Lazaro has just received a Masters degree in Civil Engineering from the State University of Iowa, Iowa City, Iowa, and is now studying construction methods with army engineers in Portland, Oregon. The second place design features a new Y-shaped steel member which serves the functions normally provided by several different members. It reduces the number of steel pieces handled, the weight of steel and the amount of welding while doubling the utility of the material used.

The $750 Third Award went to Fred C. Miller, consulting engineer, Toledo, Ohio. Miller's design employs a specially shaped piece which facilitates welding the steel pipe used for the bridge members. Besides a clean, pleasing appearance, the use of welding to join tubular members means fewer pieces of steel to handle and less cost per ton. (The use of pipe in structures, possible because

of welded connections, provides a better distribution of metal to resist stresses and results in less weight.)

Ten honorable mention awards of $100 each were also made for other outstanding bridge designs. Triangular trusses, tubular trusses and arches, closed box sections constructed of sheet metal cells, longitudinal box sections with cantilever brackets making a "backbone and rib" type of bridge, and multiple longitudinal frames with exceptionally thin material, were some of the new design ideas developed in award papers. Awards were made to designers in Holland, Canada and South Africa.

According to the Jury of Award, the many excellent bridge designs submitted contained new ideas which it is believed will influence engineering and specifications in the bridge field. Many of the new shapes evolved for the program indicate clearly the fact that present structural shapes were not designed for the most economical distribution of metal now possible with welding, but were dictated by the then existing means of fabricating.

While the selection of award designs by the Jury is not an endorsement by the Jury or by the Foundation of any of these new ideas presented, it is felt that many point the way to the welded bridge of the future.

The Chairman of the Rules Committee and Jury of Award was Wilbur M. Wilson, Research Professor of Structural Engineering, University of Illinois. He is a Life Member of the Western Society of Engineers.

Another WSE member, Harry C. Boardman, Director of Research, Chicago Bridge and Iron Company, was a member of the Rules Committee and Jury of Award.

Others members were:

Dr. E. E. Dreese, Chairman, Board of Trustees, Lincoln Foundation; and Chairman, Department of Electrical Engineering, Ohio State University.

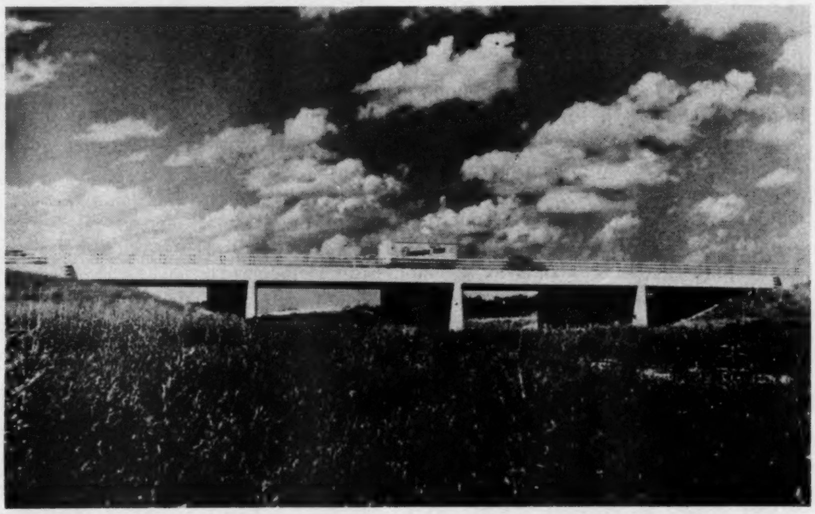
Professor James G. Clark, Department of Civil Engineering, University of Illinois.

John I. Parcel, Consulting Engineer, Sverdrup and Parcel, St. Louis, Mo.

Lee E. Philbrook, Asst. Bridge Engineer, Illinois State Division of Highways, Springfield, Illinois.

Professor Frank W. Stubbs, Jr., School of Civil Engineering and Engineering Mechanics, Purdue University.

Chicago Bridge Wins AISC Honors In Annual Design Contest



The 159th Street Overpass over the Calumet Superhighway, Cook County, Illinois, which was given an Honorable Mention in the Prize Bridge Award contest of the American Institute of Steel Construction.

A Cook County bridge has been judged one of America's most beautiful steel bridges, in a contest sponsored annually since 1928 by the American Institute of Steel Construction.

The five award winners were chosen by a jury of architects and engineers from 51 bridges opened to traffic in 1948, which were entered in the competition.

Stainless steel plaques were awarded to two bridges:

The Wautaga River Bridge, on State Highway 67, Carter County, Tennessee, winner in Class I, for bridges with spans of 400 feet or more. This bridge is owned by the State of Tennessee. It was designed by the Tennessee Valley Authority and was fabricated by the Nashville Bridge Co.

The Airport Apron Overpass, over the Van Wyck Expressway at New York International Airport, winner in Class III, for bridges with spans under 400 feet, costing less than $500,000. The owner is the City of New York, the designer was Clarke, Rapuano and Holleran and the fabricator was the American Bridge Co.

Honorable mention was given to three other bridges:

The Raymond E. Baldwin Bridge, between Old Lyme and Old Saybrook, Conn., in Class II, for bridges with spans under 400 feet, costing over $500,000. The bridge is owned by the Old Lyme-Old Saybrook Bridge Commission of the State of Connecticut. It was designed by the Division of Bridges and Structures, Connecticut State Highway Department. Howard, Needles, Tammen and Bergendoff acted as consulting engineers. The fabricator was the American Bridge Co.

The Roan Creek Bridge, at Wautaga Reservoir, Johnson County, Tenn., in Class III. The owner is Johnson County, Tenn., the designer was the Tennessee Valley Authority and the fabricator was the Nashville Bridge Co.

The 159th Street Overpass over the Calumet Superhighway, Cook County, Ill., in Class III. The owner is Cook County, the designer was the Cook County Highway Department and the fabricator was Bethlehem Steel Co.

The Jury of Award included Ralph Walker, President, American Institute of Architects, of Voorhees, Walker, Foley and Smith, New York City; Ernest J. Kump, of Kump and Falk, San Francisco, Calif.; Cyrus E. Silling, of Tucker and Silling, Charlestown, W. Va.; Prof. Warren Raeder, Head of the Department of Civil and Architectural Engineering, University of Colorado and Nathaniel A. Owings of Skidmore, Owings and Merrill, Chicago, Ill.

WSE Applications

In accordance with the By-laws of the Western Society of Engineers, the following names of applicants are being submitted to the Admissions committee for examination as to their qualifications for admission to membership into the Society in the various grades, i.e., Student, Junior, Member, Associate, etc. All applicants must meet the highest standards of character and professionalism in order to qualify for admission, and each member of the Society should be alert to his responsibility to assist the Admissions committee in establishing that these standards are met. Any member of the Society, therefore, who has information relative to the qualifications or fitness of any of the applicants listed below, should inform the Secretary's office, 84 E. Randolph St., RA ndolph 6—1736.

106-81 Dwight M. Brookens, Contract Engineer, United Conveyor Corp., 37 W. Van Buren St.

107-81 Edgar H. Maddox, Assist. Supt. Field Engrg., United Conveyor Corp., 37 W. Van Buren St.

108-81 Delbert E. Birr, Engineer, Illinois Bell Telephone Co., 212 W. Washington St.

109-81 Robert W. Harris, Traffic Engrg. Assist., Chicago Transit Authority, 79 W. Monroe St.

110-81 Jacob Sampson, 6125 N. Washtenaw Ave.

111-81 James A. Foster, Highway Engineer, Portland Cement Association, 33 W. Grand Ave.

112-81 Fred D. Ellis, President, American Engineering & Management Corp., 141 W. Jackson Blvd.

113-81 Joseph C. Ellis, Principal Assist. Engineer, American Engineering & Management Corp., 141 W. Jackson Blvd.

114-81 Howard Lavitt, 6317 N. Kenmore Ave., attending Illinois Institute of Technology.

115-81 Irwin R. Lietzke, Public Service Company of Northern Illinois, 72 W. Adams St.

116-81 F. C. Miller, Sales Engineer, Minneapolis Honeywell Regulator Co., 351 E. Ohio St.

117-81 Carl M. Jorgensen, Gen. Supt. & Vice Pres., S. N. Nielsen Company, 3059 Augusta Blvd.

118-81 Ramon A. Klitzke, 7338 Summerdale Ave., attending Illinois Institute of Technology.

119-81 Francis D. Weeks, General Dist. Engineer, General Cable Corp., 337 W. Madison St.

120-81 James W. Barnett, Sales Engineer, Lindberg Engineering Co., 2450 W. Hubbard St.

121-81 Charles T. Graves, Assist. Chief Engr., Tank Car Div., General American Transportation Corp., 131 S. Wabash Ave.

122-81 Joseph F. Wisner, Sr., Matls. Handling Research Engr., International Harvester Co., 5225 S. Western Ave.

123-81 George A. Brace, Attorney, The Hoover Co., 8 S. Michigan Ave.

124-81 Sam Ein, Engineer, Armco International Corp., 109 N. Wabash Ave.

125-81 Gilbert K. Hardacre, Manager Commercial Sales-Electric, Public Service Company of Northern Illinois, 72 W. Adams St.

126-81 Raymond D. Johnson, 2549 Budd St., River Grove, Ill., attending Illinois Institute of Technology.

127-81 Charles W. Mayer, 1014 Marengo Ave., Forest Park, Ill., attending Illinois Institute of Technology.

128-81 Kenneth E. Reed, Safety Engineer, Marsh & McLennan, Inc., 231 S. LaSalle St.

129-81 Virden E. Staff; Staff Engineer, DeLeuw, Cather & Co., 150 N. Wacker Dr.

130-81 J. Stewart Stein, Partner, Sobel & Stein, 737 N. Michigan Ave.

131-81 Lee M. Harris, Design Engineer, Sunbeam Corp., 5600 W. Roosevelt Rd.

132-81 Daniel H. Feikert, 5350 N. St. Louis Ave., attending Illinois Institute of Technology.

133-81 John A. Aldridge, Director of Research; Sears, Roebuck & Co., 925 S. Homan Ave.

134-81 C. Douglas Monsson, Field Supt. (Construction), Holabird and Root and Burgee, 180 N. Wabash Ave.

135-81 Morris Poe, Architect-Engineer, Superior Architectural Construction Co., 1417 N. Halsted St.

136-81 Paul E. Larsen, 5046 Warwick Ave., attending Illinois Institute of Technology.

137-81 Fred Mamett, 3250 W. Ogden Ave., attending Illinois Institute of Technology.

138-81 Donald R. Klusman, Engineer, Illinois Bell Telephone Co., 212 W. Washington St.

139-81 Carl Pathe, Associate to Franz Lipp, Landscape Arch., 19 E. Pearson St.

140-81 George E. Reifenstuhl, Equipment Engineer, Western Electric Ct., Hawthorne Station.

141-81 Marshall Salzman, Sec. & Treas., A. L. Salzman & Sons, 188 W. Randolph St.

142-81 Thomas J. Woods, Electrical Engineer; Chicago, North Shore & Milwaukee Railway Co., Highwood, Ill.

143-81 John M. Fries, Engineer, Hendricks Engineering Corp., 6544 Sheridan Rd.

144-81 Ralph H. Hansen, Student Engineer, Chicago Transit Authority, 79 W. Monroe St.

145-81 Thomas J. Mullin, Jr., Assist. Chief Engineer, Celotex Corp., 120 S. LaSalle St.

146-81 James W. Ooms, 146 W. 111th St., attending Illinois Institute of Technology.

147-81 George P. Torrence, President, Link-Belt Company, 307 N. Michigan Ave.

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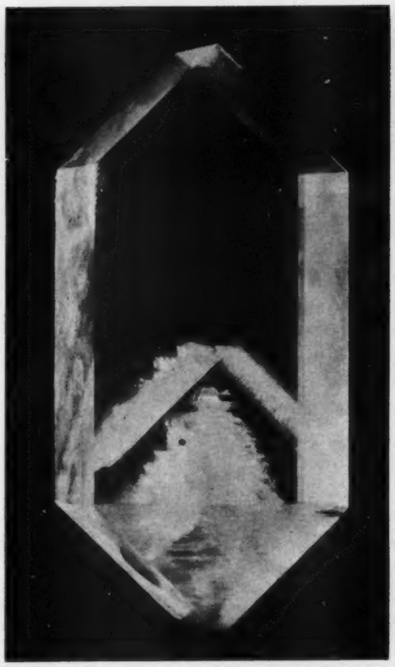
general objective a more complete knowledge of the atomic structure of semiconductors, the mechanisms of their electrical conduction, and fundamental reasons for differences in behavior of the various semiconductors and for variances brought about by impurities.

Out of this Basic Research program, in addition to much new knowledge of great value, there has recently come the discovery and invention of an amazingly simple device capable of performing efficiently a large number of the functions of an ordinary vacuum tube. We have called it the "transistor." It works on an entirely new physical principle discovered in the course of the fundamental research program referred to above. It may well have far-reaching significance in electrical communications and electronics.

The unit is housed in a tiny metal cylinder about half an inch long and less than one-quarter inch in diameter —not much larger than a shoelace tip. It will serve as an amplifier or an oscillator, yet it bears almost no resemblance to the vacuum tube now used to do these basic jobs. It has no vacuum, no glass envelope, no grid, no plate, no cathode, and therefore no warm-up delay. The principal parts of the transistor are two hair-thin wires pressing on a small disc of a solid semiconducting material, usually germanium, soldered to a metal base. One hundred of them can easily be held in the palm of the hand.

Present transistors provide a power gain of about 100 fold, and can deliver an output of about 20 milliwatts. Only half a watt is needed for their operation. This power can be obtained from a single source of about 50 volts, a voltage widely distributed in telephone plants. The ratio of output power of the transistor to its power consumption is greater than that for the most efficient vacuum tube for the equivalent service. The space occupied by the active portion of the transistor is so small, even smaller than the present housing, that we may look forward to important future savings in space occupied by telephone amplifiers. We have good reason to



One of the artificially grown EDT crystals that have been used as a substitute for quartz in electric wave filters and other communication devices.

hope for long life and for low cost through mass production.

All of these factors justify an optimistic prediction of broad use of the transistor for functions now performed by the vacuum tube. This is not to say that the transistor is likely to replace all vacuum tubes. It is at present limited in use to frequencies only up to 5 or 10 megacycles. It introduces more noise than do most vacuum tubes, and its present power handling capabilities rule it out of many fields of present vacuum tube use. On the other hand, the transistor has some properties sufficiently different from those of vacuum tubes to lead one to expect them to be used for functions that vacuum tubes do not now perform. Its present limitations, new applications, and other subjects are, of course, matters of active investigation.

The invention of the transistor was an incident, not an accident, and indeed a most important one, in the course of the Basic Research program of the semiconductor group. After the invention of the transistor, the fundamental physics of its operation were determined, and the group is now continuing its general research studies in the semiconductor field. Of course this important discovery is having its effect on the details of that program, but the program does not include the studies that would provide a broad base of new technology for use in the specific design of the many different types of transistors that will come into being. This latter work falls into the next step in the ordered procedures of "Creative Technology." We have called this step "Fundamental Development."

Almost without exception, the Basic Research step is limited to obtaining new basic knowledge, evolving completely new processes and techniques of a basic nature, and creating new instrumentalities. Our contributions to new basic knowledge in acoustics, radio propagation, piezo-electricity, and the inherent noise levels associated with the

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passage of an electric current through a resistance are examples of new basic knowledge contributed by the Basic Research step. The growing of synthetic piezo-electric crystals, such as Rochelle salt, ammonium dihydrogen phosphate, and ethylene diamine tartrate, under conditions that will produce crystals of a size and crystallographic character that permit their use as components of piezo-electric apparatus, is also an example of the evolution of new processes and techniques by the basic research step. The creation of such completely new devices as the transistor and the traveling wave tube are still further examples of creating new instrumentalities by the Basic Research step.

Our experience has indicated the importance of limiting the scope of the Basic Research step as I have described, and of keeping it separate in organization. There are several reasons for this. The most important is to insure the maintenance of a research atmosphere as nearly equivalent as possible to that of pure research. This is essential to high production in such a group. If the work of the next step, which is specifically programmed, and to an extent guided by engineering considerations, is intermingled with the Basic Research step, not only is the environment essential for Basic Research in part destroyed, but also the nonprogrammed Basic Research work tends to be subordinated to the emergencies and the pressures of specific situations that always arise in development. Further, it is difficult to attract and to hold research men of the highest ability and right temperament for Basic Research if they are made a part of the succeeding steps.

Fundamental Development

Fundamental Development, the second step in "Creative Technology," is placed under Directors of Development in an organization pattern similar to that of Basic Research. As will be described later, it is our practice to give these same directors the responsibility for the third and final step in our ordered procedure. Because of the size of our total work programs in these last two steps, there is more than one Director of Development, and the work is divided among them according to subject matter. Each Director of Development has a number of leaders of subdivisions reporting directly to him. Each leader directs the program of a specified sector of our technology.

The Fundamental Development programs are closely interlocked with the corresponding ones in Basic Research. The scientists of the Basic Research area act as educators, when required, and as consultants to the Fundamental Development staff. The work is directed toward the acquisition of the technical information, sometimes called technological "know-how," essential as a background for the design of specific devices for manufacture and use. Fundamental Development is specifically programmed, and engineering considerations, as well as the immediate information needs of design, play a prominent part in determining the subject matter of the programs. Those working in this field, therefore, do not have the freedoms that are possible and worthwhile in the basic research groups. However, they must have research ability because most of the work has the character of investigation, and is carried out in the best research tradition. It is also essential that they have not only engineering interests, but engineering aptitudes of a high order. It is obvious that the type and temperament of the man happiest and best suited to the work in this area are different from those of one who obtains greatest satisfaction in a program of basic research. Our work in fundamental development requires physicists, mathematicians, chemists, metallurgists, and electronic, communication, and mechanical engineers. A large portion of them are men with graduate training, and there is a continuing increase in the number who have their doctorates in one of the sciences or in engineering.

To illustrate the work in a particular area of Fundamental Development, it would perhaps be most logical to follow the work on the transistor through the successive steps of "Creative Technology." Since its Fundamental Development program was only recently established, however, and is still in process of expansion, it may be preferable

to turn to another illustration where the task has been completed.

For almost 40 years our Laboratories have had continuous and expanding programs of Basic Research and Fundamental Development covering all aspects of hot cathode, high-vacuum tubes for telephone uses. Employing more recent nomenclature, this work would be called "electronic research and development." These programs have been most important in the tremendous expansion of the volume and scope of telephone communication. As improved vacuum tubes with an ever-increasing variety of capabilities have been made available through these programs, new services have been created and older ones expanded and made more economical. Transcontinental telephony at audio frequencies was the first important service that resulted—now some 34 years ago. Next came the use of carrier frequencies for transmission. As new electronic and circuit knowledge became available, the number of telephone messages that each conducting pair could carry steadily increased. The load carrying capacity of already existing cable and open-wire plant has thus been greatly enhanced. During the past ten years, the carrier technique has been pushed to much higher frequencies, and it has become possible to transmit very large groups of individual telephone conversations—the present maximum being 600—through a new type of conducting pair consisting of two so-called "coaxial pipes." Each pipe acts as a one-way street, and carries one direction of the telephone conversations. It can also be equipped to transmit a television program. At the same time that these wire transmission developments were in progress, basic research and fundamental development programs were finding radio's place in telephony. Transoceanic radio-telephone, ship-to-shore radiotelephone, and vehicular radiotelephone systems were developed and services established. Had there not been a continuous flow of new basic knowledge and new technological "know-how" from our Basic Research and Fundamental Development programs in electronics, these highly significant and important advances in wire and radiotelephony would not have been possible.

Prior to 1940, our Laboratories had Basic Research studies in progress directed toward repeatered or "jump-

Winding tungsten grid wires—too small to be seen by the naked eye—for one of the grounded-grid planar triodes.

jump" radio systems for broadband telephone and television program transmission. It was recognized that such a radio service might well supplement the coaxial pipe pairs for the transmission of television programs or large groups of telephone conversations. If repeatered radio were to find a place in our broadband transmission network and to be of at least the same order of economy as the coaxial system, it was essential that an extremely high frequency, which means a very short wave length, be used as the radio carrier. Three thousand megacycles, 10 centimeter wave length, or somewhat higher was considered best. We, therefore, had Basic Research and Fundamental Development programs in progress to obtain electronic devices for this new and extremely high frequency range.

As of 1940, we had pushed the upper frequency limit only to 500 megacycles —60 centimeter wave length. At the close of the war, this forefront had been extended to about 1500 megacycles, or 20 centimeters, for amplifying tubes, which are the most essential electronic devices of the repeatered radio system. Other types of electronic devices operating up to 10,000 megacycles, or 3 centimeters, had also come into being through war developments.

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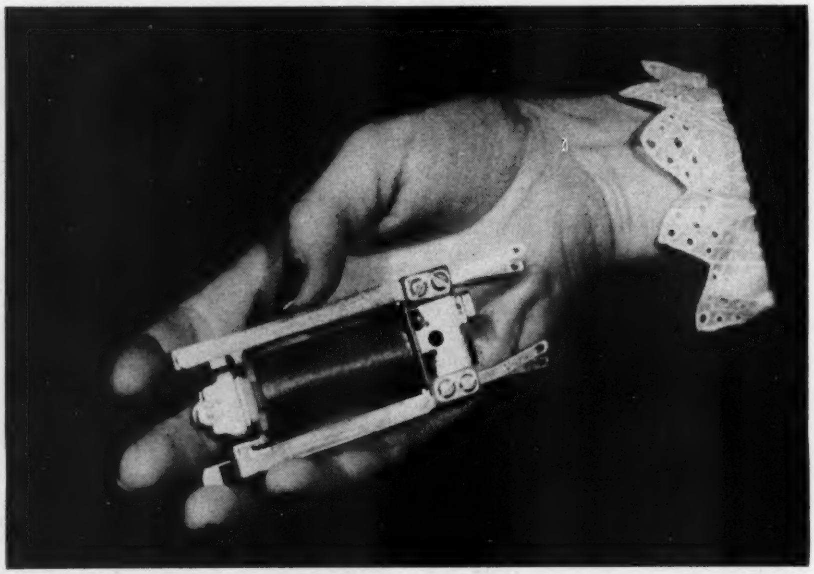
An appraisal of the technical situation for broadband repeatered radio at the close of the war led us to the conclusion that electronic devices operable in the 3000 megacycle range and with sufficient band-width for a pioneer repeatered radio system of somewhat limited length could be designed on the basis of the then available fundamental knowledge and "technical know-how." We therefore developed such a system and installed it in late 1947 between New York and Boston. There were seven repeater points, in tandem, built into suitable towers on top of high hills with an average separation of about thirty miles. The system was most successful, and is now transmitting commercial television programs between these two cities. We are also making experimental studies of the transmission of large groups of telephone conversations over the system.

The electronic heart of the system is the repeater tube that is used in amplifying the broadband current at each repeater point. It operates at 4000 megacycles, 7.5 centimeters. Several are employed at each station. It is of the velocity modulation type, and although adequate for this first installation in a circuit having only seven repeaters in tandem, it falls short of the requirements for a national system, if such there is to be, where as many as 150 repeaters might be placed in tandem. Further extension of the radio repeatered system with facilities that meet all requirements of a national system therefore awaited the development of an amplifying tube of adequate band-width operating at about 4000 megacycles and with other properties needed to meet the requirements of a national system.

An evaluation of the capabilities of the velocity modulated type of tube caused us to turn to another basic type of amplifying tube as better suited to the requirements of a national system. The so-called "grounded grid planar triode" offered a better solution for the relatively immediate future. Our technical "know-how" for the design of such tubes carried us only to 1500 megacycles, or 20 centimeters. It would, therefore, be necessary through fundamental development to acquire the technology required to extend the design "know-how" of the grounded grid planar triode from 1500 megacycles up to at least 4000 megacycles, or 7.5 centimeters.



Even though the family of relays illustrated above was giving excellent service in dial switching systems, their design was reviewed immediately after the war to take advantage of additional "know-how" which had become available.

A program was immediately planned, and work on it prosecuted with great diligence. It was successful. We obtained sufficient new "know-how" for the design of the first planar triode as a 4000 megacycle amplifier that would meet the requirements of a national system. A tube has been designed making use of this new technological knowledge. The design, manufacture, and installation schedules of the system indicate that the first installation, which will be between New York and Chicago, will be completed during next year.

As we have pushed to higher and higher frequencies, basic considerations have made it necessary to continuously decrease the space between the active elements of the tube, and to shrink the dimensions of some of its critical parts. To obtain amplifier performance at 4000 megacycles and with a sufficiently broad frequency band, it was necessary to narrow spacings and to shrink the critical dimensions of some parts well beyond anything previously considered as remotely possible. The dimensions required are those of the finest watchmaking art. Their realization in a hot-cathode vacuum tube, however, has required not only completely new mechanical arts but also new physical and chemical processes, all with controls of such an order of precision, that we might well substitute "a 4000 megacycle amplifying-tube precision" for the old saying "a watchmaker's precision."

The electron emitting coating on the cathode of the new planar triode is only .5 mil thick, while that of the older tube is four times as thick. The cathode-grid spacing of the new triode is .6 mil, while that of the older tube is ten times as great. The grid wires of the new triode are .3 mil in diameter, while those of the older tube have seven times this diameter. The grid of the new tube is wound with a pitch of 1000 turns per inch, while the winding pitch of the older tube is about one-twelfth as great.

Please observe that the coating of the cathode, the cathode-grid spacing, and the grid of the new tube all occupy a vertical space only about half that of the thickness of the cathode coating material of the earlier tube. When it is remembered that the evacuation of such a vacuum tube requires the heating of all of its parts to a temperature of about 750°C and that in operation some of the parts are at a temperature of at least 550°C, the great precision attained in this structure can be better realized.

The close spacing between the grid and the upper surface of the cathode

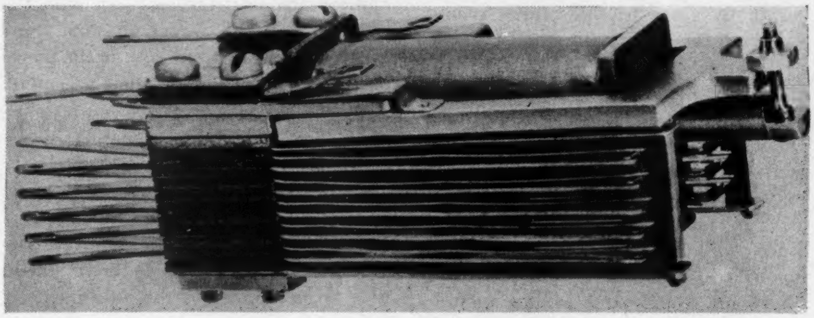
coating would not have been at all possible with the previously standard cathode coating. It was necessary to develop a much more dense coating, and also one whose thermionic emission was at least equal to that of the older art. This new coating is so dense that after it is sprayed onto the cathode surface to a depth somewhat greater than .5 mil, its surface can be milled to a thickness of .5 mil—leaving the entire cathode surface a smooth plane with deviation held within narrow limits in the next decimal place.

The grid wires are of tungsten. To obtain tungsten wire .3 mil in diameter, however, it was necessary to go to the limit of present wire drawing techniques with diamond dies and then to develop an electrochemical etching process to reduce the diameter further by a factor of almost two. This extremely fine wire is wound onto the grid frame with a tension 60% of its breaking strength.

These Fundamental Development studies were first carried on in ordinary laboratories in New York City. We soon found, however, that we made slow progress, since practically all experimental models failed in the exhaust process due either to short circuits between the cathode and grid or to low thermionic emission from the cathode. The shorts were caused by dust particles in the air, and the low thermionic emission was principally due to poisoning from gases in the air. The cathode-grid spacing had become less than the diameter of dust particles. We then provided an area where the air was specially conditioned to remove all dust particles, to remove the poisoning gases, to dehumidify, and to control the temperature. In this controlled environment satisfactory progress was realized. The manufacture of 4000 megacycle planar triode amplifiers will have to be done in similarly controlled air conditioned space.

This brings us to Design for Manufacture and Use, which is the third and final step in "Creative Technology" as practiced in our laboratories. This step provides all information essential to a complete specification for the manufacture of a new product. We have found it best not to separate this Design step so sharply from that of Fundamental Development as the latter is from Basic Research. In fact, there is an intimate association of much of the work of these two areas. You will remember that the design of the first amplifying tube for the 4000 megacycle range was carried out in close association and almost simultaneously with the determination of the new technical "know-how" of this area. The future design of amplifiers in this new frequency range will be done with less frequent contact between the Fundamental Development and Design areas than was essential in the initial design.

The Directors of Development and the leaders of the subdivisions reporting directly to them, in addition to their responsibilities for Fundamental Development, also lead our work in Design. While there is no universal pattern, usually the leader of a subdivision directs both the Development and the Design work in his sector of our technology. The men in the Design work are mostly graduate electrical, mechanical, or chemical engineers, and through experience and special formal training at our laboratories have become expert in the design procedures and techniques in the field in which they work.



The new relay structure makes possible the treatment of the different relay types as identical in assembly until the last few operations.

The content of our design programs are determined by the opportunities for advance provided by the new technological "know-how" from our fundamental development programs and from the work of others, and by the design needs of the services in which the new facilities will be used.

Bell Telephone Laboratories, as the development organization of the Bell System, has as a guiding principle the improvement of telephone service and the reduction of its cost by providing better technical facilities. In the design of a new facility, we strive for the minimum over-all operating cost consistent with high standards of service. This necessitates giving balanced consideration to the requirements of the service and to the manufacturing cost of the facility.

Our Laboratories' Design groups look to our Basic Research and Fundamental Development sectors to prescribe the functional properties of the facilities that they design. They look to the operating engineers of the system for advice in all matters relating to service,

(*Continued on Page* 30)

Organized Creative Technology

(*Continued from Page* 29)

and to the engineers of the Western Electric Company, the manufacturing unit of the Bell System, for cooperation in arriving at a design that will secure the lowest manufacturing cost consistent with our service standards, and the minimum complete cost for the service. As the design of a new facility progresses, the Laboratories' Design engineers are constantly aided by these three groups.

Design for Manufacture and Use may be illustrated by some of our work in dial switching systems. Such systems are increasingly used in establishing telephone connections. In such systems, relays are the most generally used electromechanical device; 1000 or more may go into action on a single call. Since so large a number of them are involved in each dialed call, the opportunity for trouble due to the malfunctioning of a relay is indeed large. To provide trouble-free operation, it was necessary to design relays that could be expected to operate hundreds of millions of times, in some instances almost a billion times, with a vanishingly small number of failures. Because of this severe requirement, it was unusually difficult to obtain the best possible balance between trouble-free service and minimum manufacturing cost. As a result of these varied and stringent requirements, there has resulted a family of relays with the same general basic structure, but including a large number of types. More than 200 different types were designed and placed in manufacture.

This system with its very large number of relays has given a good account of itself in telephone service, and a steadily increasing number of systems have been placed in service by the operating companies. In the postwar period, the production of several million relays has been required each year.

Even though this family of relays was giving excellent service, their design was reviewed in the period immediately after the close of the war. Much new "know-how" had become available since their basic design had been established. It was found that application of this new knowledge to the design would make worthwhile economies possible.

In the original design, more than sixty piece-parts were involved in a relay structure. To assemble and adjust this large number of piece-parts was a fairly large element of the total relay cost. By employing new techniques and new materials that had become available since the time of the initial design, the number of piece-parts was decreased approximately four-fold. This smaller number of piece-parts makes lower assembly cost. These new piece-parts were designed so that fabrication could be more completely accomplished by automatic machine processes than with the piece-parts of the previous design. Savings were thus realized both in the piece-parts themselves, and in their assembly.

The more than 200 types of relays of the original design, although of the same basic structure, differed sufficiently one from the other that straight line production technique could not be used to full advantage in their assembly. The new design makes possible the treatment of a large number of these different relay types as identical in assembly until the last few operations. For only in these final few operations do differences in structure appear. This more effective use of straight line assembly methods also makes for economy.

Although the new relay structure is radically different in design from the earlier one, a considerable number of the almost 200 relay types of the new design family are substantially interchangeable functionally with their predecessors. While lower manufacturing cost was the principal objective of the new design, advantages were realized that were not initially expected, as so frequently happens in all areas of creative technology. Among them are improved performance characteristics such as higher speed of operation and lower power consumption.

In summary, we have found that the source of inspiration of "Organized Creative Technology" is the new knowledge that comes from pure scientific research, which although usually carried out in academic institutions, is now carried out extensively in the laboratories of our industries. The contributions of this first step—Basic Research—are new basic knowledge, completely new processes and techniques of a basic nature, and the invention of new instrumentalities. The contribution of the second step—Fundamental Development—is new technical information (technological know-how) for use in the design of specific facilities. The contributions of the third and final step—Design for Manufacture and Use—are complete information and specifications for manufacture and, when required, information for use. The interlinkage of each step with the one preceding and the one succeeding it has been stressed, and the importance of team play in each of the three fields has been emphasized. The intermingling in each team of men of different training and types, and in variety and number as required by the character of the project, provides an instrument of great power and speed in the solution of the problem faced. The type and training of the men best suited to each of the three areas have been developed. A most important element in the direction of "Organized Creative Technology" is the assignment of men to the proper sales place in the stream of work according to their type and training.

"Organized Creative Technology" is dynamic—not static. Its evolution started some fifty years ago. Building on its experience of the past, and continuously strengthened by the entrance of men better prepared for its work through the steady progress of scientific and technical education in our country, it has become one of the most powerful forces in our society. The total strength of "Organized Creative Technology" in our country will continue to increase through evolution, through extension of its most effective operations to an ever greater fraction of the total of industrial laboratories, and through the growth in number and size of these laboratories.

It has made a very large contribution to the quality, scope, and variety of living, and has greatly extended the horizons of all. It made a most significant contribution to victory in the recent war, and so changed the character of war, that victory was made possible with a loss of life so small that the statistical figure of death rate for our country was scarcely affected. With its ever increasing effectiveness, we can look forward to still greater contributions to our society for its normal peaceful living, and be hopeful that its continuing contributions in the area of military preparedness may be a determining factor in the maintenance of peace.

Reviews of Technical Books

Strength of Materials

Strength of Materials, by J. P. Den Hartog, McGraw-Hill Book Co., Inc., New York, 1949. 323 pp. Price $4.00.

This textbook is designed for use as a first course in strength of materials for engineering students, but as the author states, the contents could be more accurately described as the "Statics of Deformable Elastic Bodies." The author shows how to calculate the stresses and deflections or deformations in the beams, columns, pipes or other structures as functions of the loads imposed on them, and of the dimensions of the structures.

Unique features include: the method of repeated application of the Myosotis, or cantilever formulæ in beam problems; the Mohr's circle used for moments of inertia and strains, in addition to stresses; the theory of the center of shear, and the discussion of photoelasticity, and of electric strain gages.

There are 350 problems, with answers, at the end of the text, indexed to the sections to which they apply.

This is an exceedingly well-written and well-printed textbook which will appeal to students, and also to engineers as a reference book.

H.F.W., MWSE.

Cobalt Facts

Cobalt, by Roland S. Young, Reinhold Publishing Corporation, 330 West Forty-second St., New York, 1948. 181 pp. $5.00.

This treatise is a typical monograph of the American Chemical Society series, the objective of which is to assemble authentic information relative to specific chemical subjects. In addition to the comprehensive treatment, numerous references are appended. The work is of particular value to the metallurgical chemist and to those concerned with the production, processing, and application of cobalt. While not found in abundance the element is fairly widely diffused in nature. Furthermore, it has definite uses of such importance and range that the general engineer should be acquainted with them.

It is used in extremely hard alloys to resist wear and for high speed cutting tools. It is particularly useful in construction of magnets in electrical and telephone applications. Fairly well known is its use in ceramics and glass manufacture to give color such as blue and to neutralize undesirable tints. It is an important element in artists' pigments and in commercial driers and it is the best metal known to promote adherence of enamel to steel. It is used in treatment of deficiency diseases in farm animals.

Over three-fourths of the world's cobalt come from the continent of Africa and the author, Dr. Young, is chief research chemist for several major companies operating in that field. The book is recommended for its broad coverage and authentic data.

E.B., MWSE.

Tin Technology

Tin, Its Mining, Production, Technology and Applications, by C. L. Mantell, published by Reinhold Publishing Corporation, New York, 1949. 573 pp. $10.00.

Tin is a mineral of such strategic importance that many changes have occurred in its situation within the last decade. During that period smelting and reclaiming of tin rose from minor to major rank in the United States even though raw materials are imported.

Release of this second edition is well timed and its thoroughness and dependability are assured because it is one of the monograph series of the American Chemical Society. While this treatise is particularly suited to the metallurgical chemist, it assembles all authoritative available information for the use of those in fields in which tin finds application. Among other subjects, Dr. Mantell discusses ores and ore deposits, mining and ore dressing, smelting and metallurgy, tin conversion, electrolytic tin, alloys, platings, coatings, foils, collapsible tubes, together with such subjects as corrosion and analytical methods.

This book is particularly recommended to specialists in the field, but will be interesting and valuable to those engineers who should possess a general working knowledge of the subject.

E.B., MWSE.

Mathematics

The Mathematical Solution of Engineering Problems, by Mario G. Salvadori, with a Collection of Problems by Kenneth S. Miller, McGraw-Hill Book Co., Inc., New York, 1948. 245 pp. $3.50.

This book contains, in compact form, the fundamentals of the branches of mathematics usually covered in college courses, including the calculus, and, in addition, a discussion of the Fournier series. A considerable part of the contents is therefore in the nature of a review, and also a collection of the mathematical processes commonly employed in the solution of engineering problems.

In order to awaken the interest of the engineering student the author employs the device of stating a physical problem first, and then developing the mathematical technique needed for its solution. The solution of simultaneous linear algebraic equations is treated in an unusually thorough manner.

There are included more than 1000 problems, of which about two-thirds are practice problems, and one-third applied problems from the fields of physics, mechanics, and engineering. Answers to alternate problems are given in the end of the book.

Students and engineers will find this to be a convenient volume for review and reference.

H.F.W., MWSE.

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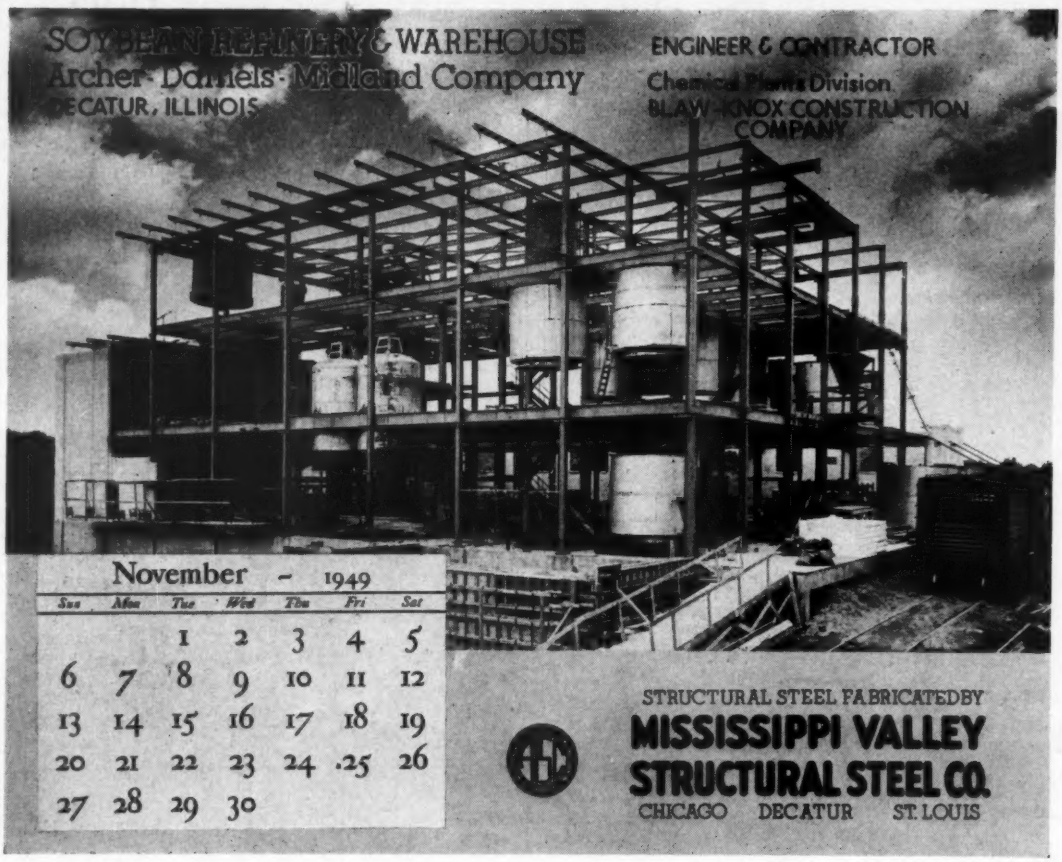
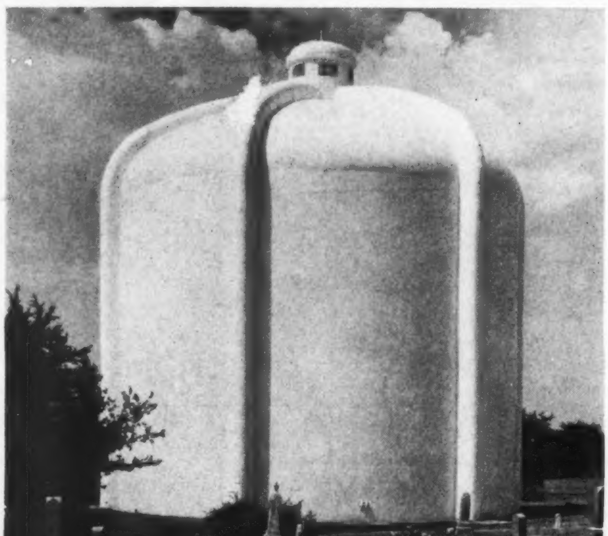


HORTON STANDPIPE SERVES MANHATTAN



The 1,250,000-gal. Horton standpipe shown here is an all welded steel structure erected for the City of Manhattan, Kan. This standpipe provides gravity water pressure to help the city's pumping equipment maintain uniform pressures in the mains and to meet peak loads.

Welded steel reservoirs are practical for furnishing gravity water pressure in a municipal water system where they can be erected on high ground. They have several advantages. Steel will not crack or leak if there is uneven settlement. The welded joints are tight and stay watertight. Maintenance costs are low, as regular painting inside and outside keeps the steel in good condition.

Ground level reservoirs are just one type of storage tanks we build for municipal water supply systems. Others include Horton elevated tanks and Horton Waterspheres. For estimating figures on these products, write our nearest office outlining your requirements.

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